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MARIANO GATDULA BASACA

On October 4, 1951, Dr. Mariano Basaca, one of our foremost Filipino bacteriologists and Chief of the Biological Research Division, Institute of Science and Technology (formerly Bureau of Science), passed to the Great Beyond in line of duty. His death is a great loss not only to the medical profession but also to science, particularly in bacteriology to which he had dedicated his life.

Dr. Mariano Basaca was born in Cabuyao, Laguna, on July 15, 1893. He studied in the Ateneo de Manila and the University of Santo Tomas where he was conferred the degrees of Bachelor of Arts and Doctor of Medicine. After graduation he served as Junior and Assistant Bacteriologist in the Bureau of Science, and then in 1924 he was sent abroad as a fellow of the Bureau of Science. While in the United States he attended the Johns Hopkins University, Harvard Medical School and Chicago Rush Medical College from 1924 to 1926.

In 1926 he returned to the Philippines and resumed his research work in the Bureau of Science as Assistant Bacteriologist in the Biological Division and later as Assistant Scientist in charge of the Biological Research Laboratory. On July 1, 1941, he was promoted to the full rank of Scientist and sometime later became Chief of the Laboratory of the Department of Health and Welfare of the City of Manila. After the liberation in 1945 when the Bureau of Science was not yet rehabilitated, Dr. Basaca served as medical officer in the Bureau of Health and then was reinstated as Scientist in the Bureau of Science. Upon the transfer of the late Dr. Marcos A. Tubangui then Chief of the Division of Biological Research to the Institute of Hygiene in 1948, Dr. Basaca became con-

currently Acting Chief of the division and Scientist. On February 20, 1951, he became Chief of Division in the Institute of Nutrition and upon his return on July 1, 1951 to the Institute of Science and Technology, he was promoted to the position of Chief, Division of Biological Research, the position he held until his death.

Dr. Basaca was a member of the National Research Council, Manila Medical Society, Philippine Society of Parasitologists, and the Colegio Medico Farmaceutico de Filipinas, and was recognized as one of the leading bacteriologists in the Philippines. He had also written several technical papers published in the *Philippine Journal of Science* and in the *Proceedings of the Society of Experimental Biology and Medicine.*

The career of Dr. Basaca is a great inspiration to the young researchers of the Philippines; for as a leader in his field he was always helpful and kind to his younger associates. Above all, he was a religiously devoted worker until his death, despite difficulties. His deep understanding of human nature made him an advocate of social justice. Although engaged in research work he did not lose the common touch and preserved that natural glamour of his lifetime. He died a true career scientist.

JUAN MANALO

AMONG HIS CONTRIBUTIONS ARE THE FOLLOWING:

BASACA, M. and OTTO SCHOBL. Contribution to the serology of leprosy. Philip. Jour. Sci. 25 (1924) 1–9.

BASACA, M., M. A. TUBANGUI and A. M. PASCO. Hexylresorcinol as an anthelmintic: its efficiency against the intestinal parasites of man. Philip. Jour. Sci. 54 (1934) 473.

BASACA, M., M. A. TUBANGUI, A. M. PASCO and F. DEL ROSARIO. Human infestation with *Ascaris* and *Trichuris* in different parts of the Philippine Islands. Philip. Jour. Sci. 55 (1934) 91–113.

BASACA, M., M. A. TUBANGUI and A. M. PASCO. Observations on the geographical distribution of hookworm parasites and hookworm disease in the Philippines. Philip. Jour. Sci. 58 (1935) 447.

BASACA, M. and M. A. TUBANGUI. Notes on the anthelmintic properties of the latex of papaya (*Carica papaya* Linn.) and of "isis" (*Ficus ulmifolia* Lam.) Philip. Jour. Sci. 77 (1947) 19.

BASACA, M. The production of yeast from molasses. Philip. Jour. Sci. 81 (1952) 75–79.

MARIANO GATDULA BASACA

PRODUCTION OF YEAST FROM MOLASSES *

By MARIANO G. BASACA

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HISTORICAL REVIEW

The history of the yeast industry had its earliest development during ancient times. The Egyptians and Babylonians at that time were already familiar with the manufacture of flour, the making of bread and the fermentation of beer. The Egyptians had probably perfected baking and brewing a thousand or more years before the Christian Era. Bakers of the middle ages were well advanced in their technics. Regulations among bakers particularly as to the weight of bread existed then. In 1775 Krüntz stated that yeasts are bodies existing in the fluid during fermentation and are driven to the surface and later settled to the bottom—this is believed to be the first definite statement in the literature regarding the nature of the substance causing fermentation. In 1792 Mason, an Englishman, prepared the first compressed yeast. The first dried yeast was sold in Vienna in 1822 by Burka.

The modern compressed yeast industry may be considered to have begun about 75 years ago with the so-called Vienna process, by which yeast was propagated in a 15° to 20° Balling, unfiltered, and unaerated grain mash made from ground kiln-dried malt and corn grist. After 20 to 23 hours the yeast was skimmed off, washed and pumped to sifting machines in order to remove the undissolved portions of the grain. The yeast was then further washed and pressed. The yeast yield from this was 10 to 14 per cent of the grain used, while alcohol yield was 30 per cent. This process was later modified by the introduction of aeration, low temperature and the use of dilute worts to increase the yeast yield to about 40 per cent and decrease alcohol fermentation to 14 to 15 per cent.

It was only in or about 1915 that Hayduck was successful in producing yeast from molasses and ammonia through neutralization of the wort during the propagation period, the initiation of growth in dilute wort and the continuous addition thereto of concentrated wort at a rate such that any alcohol formed is assimilated by the yeast during its growth. Yield

* Preliminary report.

of yeast as high as 200 per cent based on the amount of sugar in the wort have been obtained.

The production of yeast has already been highly commercialized in many countries especially in the United States but not in the Philippines. An attempt towards this direction in this country was made in 1949 in response to the national campaign of food production. It was thought that the high content of yeast may contribute to solve the food shortage problems. To produce meat from animals it requires months and years, cereals—months, vegetables—weeks, while yeast needs only hours or days. It was found out that during World Wars I and II, Germany resorted to this kind of food. The American Army in the last war was well supplied with food yeast. Yeast is not only necessary as a source of protein in times of emergency but also in times of peace especially when natural protein foods are very expensive.

MATERIALS AND METHODS

The method used was based on the paper of Arthur J. Nolte[8] et al on "Feed-Yeast and Industrial Alcohol from Citrus-Waste Press Juice."

Torulopsis utilis was used due to its rapid multiplication which is three times as rapid as baker's yeast and its low production of alcohol. Furthermore, *T. utilis* has the ability to assimilate pentoses and to synthesize Vitamin B complex, nicotinic acid and glutathione from sugar and mineral salts in nutritive media.

Molasses was used as the main source of sugar for yeast culture because of its abundance in the Philippines and Trisodium phosphate and ammonium sulfate as nutrients.

Preparation of seed.—From pure stock culture of *T. utilis*, transplant was made into 12 large tubes of Sabourand's maltose agar slants and after 48 hours at room temperature, the growth was washed off and inoculated into the propagating wort.

Pretreatment of molasses.—250 cc of molasses were diluted with an equal part of water and 1.6 cc concentrated H_2SO_4 CP added. The mixture was sterilized for 40 minutes at 15 lbs. pressure. The sugar content of this dilution was about 30 per cent based on total sugar content of raw molasses with a total sugar content of 60 per cent based on Fehling's test. This was filtered through a super-centrifuge to remove the organic matter in suspension which imparted a dark color to the yeast and to eliminate the calcium salts which remained in suspen-

sion. Excessive calcium salts in the medium produces a deleterious effect on the growth of yeast.

Actual propagation.—The above mixture was diluted to 13 liters with tap water and 50 cc of N1 H_2SO_4 added. The clear filtrate was placed in a glass container or propagation vat and after adding 14.6 grams of amonium sulfate and 12.6 grams of trisodium phosphate the set up was ready for the addition of the seed. Every hour afterwards for six times, 3 grams of ammonium sulfate were added. Four hours after the start of the propagation 6 grams of sodium carbonate were added and again 2 hours afterwards.

Aeration was effected by means of a regular Mandler filter No. 3–5″ x 1″ test 4 lbs. pressure connected directly to an air pump and provided with a cotton filter and the pressure or amount of flow of air was regulated. Aeration was necessary to replace dissolved oxygen. It is also believed that aeration takes away fermented products from the surface of the cells and substitutes fresh nutrients for them. Agitation also increased yeast yield.

The addition of sodium carbonate was necessary to maintain the pH of the wort between 4.4 and 6.5.

At the end of eight hours the propagation was stopped. It was then passed through a supercentrifuge. The sediment was washed with tap water and centrifuged at 3500 r.p.m. for 30 minutes. The sediment was then placed in a double boiler for 6 hours to remove some of the moisture. Then it was placed in a vacuum oven at 70°C for 2 to 3 days.

The dried yeast was ground through a corn mill and further pulverized in a hand stone mortar. The finished product was stored in bottles and kept in the incubator at 37°C to avoid absorption of moisture.

Results.—The average yield in 32 runs of this propagation was 285 grams of dry yeast or 190 per cent based on total sugars of the wort (150 gm.) or 570 per cent based on seed (50 gms.) The highest yield was 300 gms. of dry yeast or 200 per cent based on total sugars or 600 per cent based on seed.

A composite powdered yeast of several runs was examined chemically by standard test and the following results were obtained:

	Per cent		Per cent
Moisture	7.5	.....	Moisture free (dried to 100°C)
Protein	48.2	.....	52.1

	Per cent	Per cent
Glycogen	12.5	13.52
Fat	4.33	4.7
Ash	6.2	6.7
Minerals or ash		
Calcium as calcium oxide		0.9
Manganese		4.2
Phosphorus as P_2O_5		44.6
Sodium oxide and potassium oxide		37.71

Discussion.—The writer believes that with better equipment and apparatus the yeast yield from molasses using the above procedure can be still increased. The composition of the yeast obtained did not vary much from that obtained by Nolte, as shown by the accompanying table of comparison:

Comparative composition of yeast

	By Nolte method *Per cent*	This method *Per cent*
Moisture	1.29	Moisture free
Protein	52.28	52.1
Glycogen	12.78	13.52
Fat	4.51	4.7
Ash	8.08	6.7

The composition of yeast as compared with that of common vegetable foods, is remarkable for its high content of protein and glycogen and its low fat. According to F. O. Reed, this yeast when added to cereal foods has been shown to improve the nutritive value greatly by supplying the amino acids which are deficient in cereal proteins. As little as 0.5 oz. per day would sufficiently enrich the normal diet. Food yeast is not eaten in powder form. It is added to food with no change or just a slight effect on the taste. The taste is rather conventional, the odor is similar to malted foods and the color is light brown. These characteristics of yeast powder make it acceptable as a food supplement.

Conclusion.—The low cost of production, the short time required to propagate yeast so that if it is necessary a 24-hour run or a shift of every 8 hours can be easily done, its high nutritive value as a food supplement—all these should encourage the establishment of a pilot plant so that food yeast can be produced in large scale.

ACKNOWLEDGMENT

The writer wishes to acknowledge the services of Miss Dolores Hipolito who was responsible for the chemical analysis of the yeast. The writer is likewise deeply indebted to Mr.

Benisio Leonen who rendered invaluable service, who many a time had to work beyond call of duty so that this project may be carried out successfully.

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GRAMMITIDACEÆ OF NEW GUINEA *

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TEN PLATES

This paper is in part a report on the ferns collected by the third Archbold Expedition to New Guinea, in collaboration with the Government of Netherlands Indies. The previous reports were published in the Philippine Journal of Science **73** (1940) 345 and 457; **75** (1941) 347; **76** (1941) 23; and **78** (1949) 207; and Univ. Calif. Publ. Bot. **18** (1942) 217.

A report on this group of ferns was prepared in 1939 and 1940, and submitted for publication on May 10, 1940. Proof was read and returned September 1, 1941. It then became a casualty of war. To guard the new names, these were published, with brief, merely legal diagnosis, in Univ. Calif. Publ. Bot. **18** (1942) 217–226. The descriptions and illustrations, necessary to make these novelties certainly and easily recognizable, were published as to the genus *Grammitis* in my monograph of that genus, Philip. Jour. Sci. **80** (1951) 95. As to the other genera, they appear here for the first time.

Key to the genera

Sori protected by folding of fertile segment.
  Protective fold free ..... 4. *Calymmodon*
  Fold fused over sorus ..... 5. *Acrosorus*
Sori not protected by folding of segment.
  Sporangia in round or oblong sori.
    Fronds simple or shallowly lobed ..... 1. *Grammitis*
    Fronds pinnatifid or pinnate.
      Veins in segments simple or forked ..... 3. *Xiphopteris*
      Veins pinnate in segment or pinna.
        Sori dorsal ..... 6. *Ctenopteris*
        Sori immersed in or near margin ..... 7. *Prosaptia*
  Sori in elongate coenosori.
    Sori parallel to costa, vein free ..... 2. *Scleroglossum*
    Sori normally oblique to costa, venation reticulate.. 8. *Loxogramme*

* During the past decade, our ideas as to the systematic status of this group have changed materially. Accordingly, I have rewritten this paper treating what was definite but nameless group as a family, coordinate with Polypodiaceæ in the present restricted sense.

I. GRAMMITIS Swartz

As this genus has recently been monographed, it may suffice to present here a key to the New Guinea species and an enumeration.

Key to the species

Stipes naked or glabrescent.
- Sori superficial or nearly so.
  - Stipe at least half as long as lamina ..... 1. *G. caricifolia*
  - Stipe relatively short.
    - Lamina not over 5 cm long ..... 2. *G. oblanceolata*
      3. *G. reducta*
      P. viridulum
    - Lamina 7 to 15 cm long ..... 4. *G. stanleyana*
    - Lamina longer.
      - Fronds 3 mm wide ..... 5. *G. graminifolia*
      - Fronds 5 to 6 mm wide ..... 6. *G. frigida*
      - Fronds 10 to 12 mm wide.
        - Stipe 0 to 2 cm long ..... 7. *G. subfasciata*
        - Stipe 3 to 8 cm long ..... 8. *G. integra*
- Sori impressed or immersed.
  - Stipe longer than fertile lamina ..... 10. *G. interrupta*
  - Stipe shorter than lamina.
    - Stipe 4 cm long or longer.
      - Sori in deep clefts ..... 14. *G. locellata*
      - Sori in deep clefts ..... 11. *G. plurisetulosa*
    - Stipe 0 to 2 cm long.
      - Soral pits close together ..... 9. *G. pleurogrammoides*
      - Soral pits not contiguous.
        - Borders of pits naked ..... 12. *G. loculosa*
        - Borders of pits hairy ..... 13. *G. dictymioides*

Stipes hairy.
- Bases of stipe-hairs enlarged.
  - Sori impressed, uniseriate ..... 16. *G. scabristipes*
  - Sori superficial, some scattered ..... 17. *G. novoguineensis*
- Bases of hairs not enlarged.
  - Fronds small, thin, paleae undeveloped.
    - Hairs of frond under 0.5 mm long..... 18. *G. coredrosora*
    - Hairs over 1 mm long ..... 19. *G. parva*
  - Fronds mostly larger, paleae developed.
    - Sori deeply immersed.
      - Soral pits open, oblong ..... 12. *G. loculosa*
      - Pits linear, opening at maturity..... 15. *G. stomatocarpa*
    - Sori superficial or moderately impressed.
      - Stipes velutinous, hairs up to 0.6 mm long.
        - Veins normally once forked ..... 20. *G. mesocarpa*
        - Veins forked more than once.
          - Sori rather scattered ..... 21. *G. sumatrana*
          - Sori regularly seriate ..... 22. *G. subrepanda*
            P. torricellianum
            P. carstenszense.

Stipes with deciduous short hairs..... 6. *G. frigida*
Hairs of stipe 1 mm long or longer.
Laminar surface naked.
Veins simple ..... 26. *P. sucklingianum*
Veins once forked, veinlets equal.
Stipe densely hairy ..... 27. *G. ciliolata*
Stipe sparsely hairy ..... 28. *G. ceratocarpa*
Veinlets more numerous, unequal.
Stipe sparsely hairy.
Stipe 5 to 10 cm long..... 24. *G. Archboldii*
Stipe 1 to 2 cm long..... 25. *P. diplosoroides*
Stipe moderately hairy ..... 29. *G. dolichosora*
Stipe densely hairy ..... 47. *G. knutsfordiana*
Laminar surface more or less setose.
Sori partly scattered ..... 23. *G. subreticulata*
Sori strictly uniseriate.
Fronds sessile ..... 30. *P. papuense*
Fronds stipitate.
Fertile veinlet ending in sorus.
Veins once forked..... 31. *G. Mariae*
Margin inciso-crenate.....
Margin entire.
Frond 10 cm by 3 mm .. 32. *G. hirtiformis*
Frond 10 cm by 7 mm .... 33. *G. matapensis*
Frond much larger..... 39. *G. ornatissima*
Veins twice forked.
Hairs sparse and long ..... 47. *G. knutsfordiana*
Bristles minute, dense..... 48. *G. hispida*
Fertile veinlet prolonged.
Stipe 1/10 as long as lamina.
Frond densely hairy..... 38. *G. habbemensis*
Frond sparsely hairy..... 37. *G. inconstans*
Stipe relatively long.
Frond ca. 3 cm long ..... 46. *G. murrayana*
Frond larger.
Veins once forked.
Veins at about 45°.
Fronds moderately hairy.
Densely ciliate.. 42. *G. cyclosora*
Sparsely ciliate.
Veins approaching margin ..... 35. *G. Myer-Dreesii*
Veins far from margin ..... 36. *G. brevisetulosa*
Fronds extremely hairy ..... 41. *G. trogophylla*
Veins at an acute angle.
Stipe weak ..... 34. *G. debilifolia*
Stipe firm ..... 40. *G. mollipila*
Veins more divided.

Apex attenuate.
Paleae brown ..... 43. *G. trichopoda*
Paleae black ..... 44. *G. nigropaleata*
Apex abrupt ..... 45. *G. fasciculata.*
Monstrosities with repeatedly forked fronds .... *P. fuciforme*
P. alcicorne
P. dichotoma

1. GRAMMITIS CARICIFOLIA Copel.

G. caricifolia COPEL., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 166.

Mt. Sarawaket, *Clemens*; Mt. Wilhelmina, *Brass 9410.* Alpine.

Endemic.

2. GRAMMITIS OBLANCEOLATA (Baker) Copel.

G. oblanceolata (Baker) COPEL., Philip. Jour. Sci. 80 (1951) 166.
Polypodium oblanceolatum BAKER, Ann. of Bot. 8 (1894) 128.

Mt. Suckling, *MacGregor; Carr 13665.*

Endemic.

POLYPODIUM VIRIDULUM v.A.v.R.

Polypodium viridulum v.A.v.R., Nova Guinea 14 (1924) 41.

Doorman Summit, alt. 2,500 m.

I have not seen this, and, by description, do not distinguish it from *G. oblanceolata.*

3. GRAMMITIS REDUCTA (v.A.v.R.) Copel.

G. reducta (v.A.v.R.) COPEL., Philip. Jour. Sci. 80 (1951) 167.
Polypodium reductum v.A.v.R., Nova Guinea 14 (1924) 41.

Near Doorman Summit, alt. 1,420 m, *Lam 1549, 1550.* There are forked fronds in both collections.

Endemic.

4. GRAMMITIS STANLEYANA (Baker) Copel.

G. stanleyana (Baker) COPEL., Philip. Jour. Sci. 80 (1951) 168.
Polypodium stanleyanum BAKER, Jour. Bot. 28 (1890) 107.
P. trichocarpum v.A.v.R., Nova Guinea 14 (1924) 41.

Apparently common at major altitudes; epiphytic and terrestrial.

Endemic.

5. GRAMMITIS GRAMINIFOLIA Copel.

G. graminifolia COPEL., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 169.

Mt. Tafa, alt. 2,400 m, *Brass 5092;* Lake Habbema, alt. 3,225 m, *Brass 9111.* Terrestrial.

Endemic.

6. GRAMMITIS FRIGIDA (Ridley) Copel.

G. frigida (Ridley) COPEL., Philip. Jour. Sci. 80 (1951) 170.
Polypodium frigidum RIDLEY, Trans. Linn. Soc. Bot. 9 (1916) 259.

DUTCH NEW GUINEA, alt. 3,500 m, *Boden Kloss;* Bele River, alt. 2,200 m, *Brass 11272, 11267.*

Endemic.

7. GRAMMITIS SUBFASCIATA (Ros.) Copel.

G. subfasciata (Ros.) COPEL., Philip. Jour. Sci. 80 (1951) 170.
Polypodium subfasciatum Ros., Fedde's Repert. 5 (1908) 41.

Mt. Gelu, alt. 1,000 m, *Werner 25.*

Endemic.

8. GRAMMITIS INTEGRA (Brause) Copel.

G. integra (Brause) COPEL., Philip. Jour. Sci. 80 (1951) 171.
Polypodium integrum BRAUSE, Engl. Jahrb. 49 (1912) 37.

GERMAN NEW GUINEA, alt. 1,200 m, *Schulze;* Lake Habbema, alt. 3,225 m, *Brass 9358,* epiphytic or terrestrial.

Endemic. Possibly the same as *G. subfasciata.*

9. GRAMMITIS PLEUROGRAMMOIDES (Ros.) Copel.

G. pleurogrammoides (Ros.) COPEL., Genera (1947) 213; Philip. Jour. Sci. 80 (1951) 172.
Polypodium pleurogrammoides Ros., Fedde's Repert. 5 (1908) 42.

Mt. Gelu, alt. 1,700 m, *Werner 22;* Idenburg River, alt. 1,600 m, *Brass 12734.*

This species may represent the ancestry of *Scleroglossum.*

Endemic.

10. GRAMMITIS INTERRUPTA (Baker) Copel.

G. interrupta (Baker) COPEL., Genera (1947) 214.
Monogramma interrupta BAKER, Annals Bot. 5 (1891) 482.
Pleurogramme interrupta CHRIST, Farnkr. der Erde (1897) 55.
Nematopteris interrupta C. CHR., Dansk bot. Arkiv. 6 (1929) 31.
Polypodium pyxidiforme v.A.v.R., Bull. Jard. Buit. II 1 (1911) 29.

Mt. Yule; Dutch New Guinea, *Lam 1051;* Idenburg River, alt. 2,000 m, *Brass 11863, 12603.*

Endemic.

11. GRAMMITIS PLURISETULOSA Copel.

G. plurisetulosa COPEL., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 174.

Mt. Wilhelmina; Mt. Bolan; Mt. Sarawaket; Mt. Albert Edward. Alpine.

Endemic.

12. GRAMMITIS LOCULOSA (v.A.v.R.) Copel.

G. loculosa (v.A.v.R.) COPEL., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 175.
Polypodium loculosum v.A.v.R., Nova Guinea 14 (1924) 42.

Doorman River, alt. 200 m, *Lam 1267.*
Endemic.

13. GRAMMITIS DICTYMIOIDES Copel.

G. dictymioides COPEL., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 175.

Lake Habbema, alt. 3,225 m, *Brass 11848, 9375, 9059.*
Anastomosing veins are common.
Endemic.

14. GRAMMITIS LOCELLATA (Baker) Copel.

G. locellata (Baker) COPEL., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 176.
Polypodium locellatum BAKER, Philip. Jour. Sci. 80 (1951) 176.

Mt. Victoria; Mt. Sarawaket, *Clemens.*
Endemic.

15. GRAMMITIS STOMATOCARPA Copel.

G. stomatocarpa COPEL., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 177.

Mt. Wilhelmina, in subalpine forest, alt. 3,650 m. *Brass 9858a; 9630;* Lake Habbema, alt. 3,225 m, *Brass 9219.*
Endemic.

16. GRAMMITIS SCABRISTIPES (Baker) Copel.

G. scabristipes (Baker) COPEL., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 178.
Polypodium scabristipes Baker, Jour. Bot. 28 (1890) 108.

Apparently common at major altitudes.
Endemic.

17. GRAMMITIS NOVOGUINEENSIS Copel.

G. novoguineensis COPEL., U. C. Publ. Bot. 18 (1942) 22; Philip. Jour. Sci. 80 (1951) 178.
Polypodium diplosorum f. grammitoides Ros. in herb.

Bolan, alt. 3,400 to 3,800 m, *Bamler B 41; Keysser B 1;* the latter collection bears pinna-like lateral outgrowths up to 4 cm long.
Endemic.

18. GRAMMITIS COREDROSORA (v.A.v.R.) Copel.

G. coredrosora (v.A.v.R.) COPEL., Philip. Jour. Sci. 80 (1951) 179.
Polypodium coredrosorum v.A.v.R., Nova Guinea 14 (1924) 44.

Ridge near Doorman Summit, alt. 1,420 m, *Lam 1550a.*
Endemic.

19. GRAMMITIS PARVA (Brause) Copel.

G. parva (Brause) COPEL., Genera (1947) 211; Philip. Jour. Sci. 80 (1951) 180.
Polypodium parvum BRAUSE, Engl. Jahrb. 49 (1912) 36.

Finisterre and Kani ranges, alt. 1,000 m, *Schlechter 18033* and *17156*. *Carr 13525*, from Boridi, is referred to this species by Alston.

Endemic.

20. GRAMMITIS MESOCARPA (v.A.v.R.) Copel.

G. mesocarpa (v.A.v.R.) COPEL., Philip. Jour. Sci. 80 (1951) 181.
Polypodium mesocarpum v.A.v.R., Nova Guinea 14 (1924) 42.

Doorman Summit, alt. 1,420 to 1,450 m, *Lam 1487, 1878, Brass 12009*, from Idenburg River region, alt. 1,800 m, probably represents this species.

Endemic.

G. adspersa (Blume) Copel. (as *Polypodium malaicum*) is reported from the Hellwig Mountains by Rosenstock, Nova Guinea 8 (1912) 725, the specimen being *v. Roemer 1168*. This species is common farther West, but I have not seen it from New Guinea.

21. GRAMMITIS SUMATRANA (Baker) Copel.

G. sumatrana (Baker) COPEL., Philip. Jour. Sci. 56 (1935) 97; 80 (1951) 181.
Polypodium sumatranum BAKER, Journal Bot. 18 (1880) 214.
P. serraeforme BRAUSE, Engl. Jahrb. 49 (1912) 36, *non* J. Sm.
P. brauseanum v.A.v.R., Malayan Ferns Suppl. (1917) 521.
P. biseriale RIDLEY, Trans. Linn. Soc. Bot. II 9 (1916) 260.

Finisterre Mts. alt. 950 m, *Schlechter 18142*, type collection of *P. serraeforme*.

JAVA; SUMATRA; PHILIPPINES.

22. GRAMMITIS SUBREPANDA (Brause) Copel.

G. subrepanda (Brause) COPEL., Philip. Jour. Sci. 80 (1951) 183.
Polypodium subrepandum Brause, Engl. Jahrb. 49 (1912) 37.

German and Dutch New Guinea, many collections, alt. 1,200 to 2,800 m.

Endemic (or possibly in Borneo).

Doubtfully distinct from this species are *Polypodium torricellianum* Brause, Engl. Jahrb. 49 (1912) 45, *f. 3 A*, and *P. carstenszense* Ridley, Trans. Linn. Soc. Bot. II 9 (1916) 260.

23. GRAMMITIS SUBRETICULATA Copel.

G. subreticulata COPEL., Philip. Jour. Sci. 80 (1951) 185.
Polypodium subreticulatum COPEL., Philip. Jour. Sci. § C 9 (1914) 6.

Taupota, Papua, *King 395, 1. Shaw.*
Known by a single collection.

24. GRAMMITIS ARCHBOLDII (C. Chr.) Copel.

G. Archboldii (C. Chr.) COPEL., Philip. Jour. Sci. 80 (1951) 186.
Polypodium Archboldii C. CHR., Brittonia 2 (1937) 305.

Mt. Albert Edward, alt. 3,680 m, *Brass 4236, 4259;* Mt. Tafa, alt. 2,400 m, *Brass 5093.*
Endemic.

25. POLYPODIUM DIPLOSOROIDES Ros.

Polypodium diplosoroides ROS., Nova Guinea 8 (1912) 724.
Hellwig Mts., alt. 1,350 to 1,600 m, *v. Roemer nos. 1167, 1317.*
Endemic.

26. POLYPODIUM SUCKLINGIANUM Baker

Polypodium sucklingianum BAKER, Annals Bot. 8 (1894) 128.
Mt. Suckling, received by MacGregor from F. Mueller.
Endemic.

I have not seen this or the preceding species, and hesitate to transfer their names.

27. GRAMMITIS CILIOLATA (v.A.v.R.) Copel.

G. ciliolata (v.A.v.R.) COPEL., Philip. Jour. Sci. 80 (18951) 117.
Polypodium ciliolatum v.A.v.R., Nova Guinea 14 (1924) 43.

Near Doorman Summit, alt. 1,420 m, *Lam 1518.*
Endemic.

28. GRAMMITIS CERATOCARPA Copel.

G. ceratocarpa COPEL., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 188.

Morobe, alt. 3,000 m, *Clemens 11349.*
Endemic.

29. GRAMMITIS DOLICHOSORA Copel.

G. dolichosora COPEL., Philip. Jour. Sci. 80 (1951) 188.
Polypodium dolichosorum COPEL., Philip. Jour. Sci. 1 Suppl. (1906) 159, *pl. 16.*

Nassau Mts., *v. Leeuwen 10929;* Sepik region, *Ledermann.*
MINDANAO; BORNEO.

30. POLYPODIUM PAPUENSE v.A.v.R.

Polypodium papuense v.A.v.R., Malayan Ferns Suppl. (1917) 521.
P. papuanum Ridley, Trans. Linn. Soc. Bot. 9 (1916) 261, *non* Baker.

DUTCH NEW GUINEA, alt. 2,500 feet.
Unknown to me.

31. GRAMMITIS MARIAE Copel.

G. Mariae COPEL., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 189.

Morobe, alt. 8,000 to 10,000 feet, *Clemens 10251a;* Rawlinson range, alt. 12,000 feet, *Clemens.*

Endemic.

32. **GRAMMITIS HIRTIFORMIS (Ros.) Copel.**

G. hirtiformis (Ros.) Copel., Philip Jour. Sci. 80 (1951) 190.
Polypodium hirtiforme Ros., Fedde's Repert. 12 (1913) 176.

Bolan Mts., alt. 2,400 to 3,000 m, *Keysser B 48.*

Endemic .

33. **GRAMMITIS MATAPENSIS Copel.**

G. matapensis Copel., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 191.

Morobe, alt. 1,700 m, *Clemens 11176.*

Endemic.

34. **GRAMMITIS DEBILIFOLIA Copel.**

G. debilifolia Copel., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 191.

Mt. Wilhelmina, alt. 3,800 m, *Brass* and *Myer–Drees 10036.*

Here, *fide* Alston, belong also *Carr 15130,* and *Clemens 7343, 6236,* and *6233,* from Mt. Sarawaket.

Endemic.

35. **GRAMMITIS MYER-DREESII Copel.**

G. Myer-Dreesii Copel., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 192.

Near Mt. Wilhelmina, alt. 3,580 m, *Brass* and *Myer–Drees 9898.*

Endemic.

36. **GRAMMITIS BREVISETULOSA Copel.**

G. brevisetulosa Copel., U. C. Publ. Bot. 18 (1942) 223.

Morobe, alt. 1,700 m, *Clemens.*

Endemic.

37. **GRAMMITIS INCONSTANS (v.A.v.R.) Copel.**

G. inconstans (v.A.v.R.) Copel., Philip. Jour. Sci. 80 (1951) 193.
Polypodium inconstans v.A.v.R., Nova Guinea 14 (1924) 43.

Near Doorman Summit, alt. 1,450 m, *Lam 1882.*

Endemic.

38. **GRAMMITIS HABBEMENSIS Copel.**

G. habbemensis Copel., U. C. Publ. Bot. 18 (1942) 223; Philip. Jour. Sci. 80 (1951) 194.

Near Lake Habbema, alt. 2,860 m, *Brass 10520.*

Endemic.

Alston believes this to be *G. oblanceolata.*

39. GRAMMITIS ORNATISSIMA (Ros.) Copel.

G. ornatissima (Ros.) COPEL., Philip. Jour. Sci. 80 (1951) 195.
Polypodium ornatissimum Ros., Fedde's Repert. 5 (1908) 41.

Mt. Gelu, alt. 1,000 m, *Werner 47; v. Roemer 734, fide* Rosenstock.

Endemic.

Brause, Engl. Jahrb. 56 (1920) 180, describes var. *dichotomum*, with narrow, dichotomous fronds; *Ledermann 11809.*

40. GRAMMITIS MOLLIPILA (Baker) Copel.

G. mollipila (Baker) COPEL., U. C. Publ. Bot. 18 (1942) 224; Philip. Jour. Sci. 80 (1951) 195.
Polypodium mollipilum BAKER, Jour. Bot. 28 (1890) 107; Christensen, Brittonia 2 (1937) 305.

Near Mt. Wilhelmina, alt. 3,580 m, *Brass* and *Myer-Drees 9841* (?).

Endemic.

41. GRAMMITIS TROGOPHYLLA Copel.

G. trogophylla COPEL., U. C. Publ. Bot. 18 (1942) 224; Philip Jour. Sci. 80 (1951) 196.

Mt. Sarawaket, alt. 9,000 to 12,000 feet, *Clemens 10087* and *s. n.; Brass 9855*, from Mt. Wilhelmina, is approximately the same.

Endemic.

42. GRAMMITIS CYCLOSORA Copel.

G. cyclosora COPEL., U. C. Publ. Bot. 18 (1942) 224; Philip. Jour. Sci. 80 (1951) 197.

Mt. Sarawaket, alt. 11,000 to 12,500 feet, *Clemens.*

Endemic.

43. GRAMMITIS TRICHOPADA (Mueller and Baker) Copel.

G. trichopoda (Mueller and Baker) COPEL., U. C. Publ. Bot. 18 (1942) 224; Philip. Jour. Sci. 80 (1951) 197.
Polypodium trichopodum F. MUELLER, Trans. R. Soc. Victoria 1 (1889) 40; Jour. Bot. 28 (1890) 107; C. CHR., Brittonia 2 (1937) 305.

Mt. Albert Edward, alt. 3,680 m, *Brass 4260.*

Var. *serrato-lobatum* Brause, Engl. Jahrb. 56 (1920) 179, from the Sepik region, alt. 1,150 m, *Ledermann 11576*, is peculiar in several respects, permitting doubt that it belongs in this species.

Endemic.

44. GRAMMITIS NIGROPALEATA Copel.

G. nigropaleata COPEL., U. C. Publ. Bot. 18 (1942) 223; Philip Jour. Sci. 80 (1951) 198.

Morobe, alt. 1,700 m, *Clemens 41018.*
Endemic.

45. GRAMMITIS FASCICULATA Blume

G. fasciculata BLUME, Flora Javae 2 (1828) 112, *plate 47, f. 2;* Philip. Jour. Sci. 80 (1951) 198.

Mt. Wilhelmina, alt. 4,050 m, in rock hole in open grassland; *Brass* and *Myer–Drees 10042A.*
Malay and Philippines; common and showy.

46. GRAMMITIS MURRAYANA (C. Chr.) Copel.

G. murrayana (C. Chr.) COPEL., Philip Jour. Sci. 80 (1951) 200.
Polypodium murrayanum C. CHR., Brittonia 2 (1937) 304.

Wharton Range, alt. 2,840 m, *Brass 4726.*
Endemic.

47. GRAMMITIS KNUTSFORDIANA (Baker) Copel.

G. knutsfordiana (Baker) COPEL., U. C. Publ. Bot. 18 (1942) 224; Philip. Jour. Sci. 80 (1951) 201.
Polypodium knutsfordianum Baker, Journal of Bot. 28 (1890) 107; Annals of Bot. 8 (1894) 128.

Apparently common. The veins are very conspicuous.
BATJAN; MINDANAO; BORNEO.

48. GRAMMITIS HISPIDA Copel.

G. hispida COPEL., U. C. Publ. Bot. 18 (1942) 224; Philip Jour. Sci. 80 (1951) 203.

Near Lake Habbema, alt. 2,800 m, *Brass 10257, 10284.*
Endemic.

POLYPODIUM FUCIFORME Ros.

P. fuciforme ROS., Nova Guinea 8 (1912) 726.
P. dichotomum BRAUSE, Engl. Jahrb. 56 (1920) 190, *nec aliorum.*
P. alcicorne RIDLEY, Trans. Linn. Soc. Bot. 9 (1916) 261, *non* Baker.

These three are apparently monstrosities, and do not represent proper species.

2. SCLEROGLOSSUM van Alderwerelt van Rosenburgh

Christensen, Dansk bot. Arkiv 6 2 (1929), reports from New Guinea *S. debile* (Kuhn) v.A.v.R., *S. pusillum* (Blume) v.A.v.R. and a variety *angustissimum* (Copel.) C. Chr., and *S. sulcatum* (Kuhn) v.A.v.R., and presents a key for their discrimination:

Leaf-edge outside the groove attenuate towards the margin.
  Small (2–3 cm by 1–2 mm); most veins simple; leaf-edge outside the groove about as broad as the costal parenchyma ..... 1. *S. debile*
  Larger (5–10 cm by 3–4 mm); leaf-edge at most half as broad as costal parenchyma ..... 2. *S. pusillum*
Leaf-edge thick, angular or round ..... 3. *S. sulcatum*

Christensen's treatment is unsatisfactory to its author, and probably no less so to me, but it does make clear the difficulty of distinguishing species in this genus. My presentation, which follows, is likewise unsatisfactory.

Sorus marginal or nearly so.
  Fertile portion of frond not dilated ..... 1. *S. debile*
  Fertile portion abruptly dilated ..... 2. *S. juncifolium*
Sorus nearer to costa than to margin ..... 3. *"T." simplicivenia*

1. **SCLEROGLOSSUM DEBILE** (Kuhn) v.A.v.R.

S. debile (Kuhn) v.A.v.R., Bull. Jard. Buit. II 1 (1912) 39.
Vittaria debilis Kuhn, Linnaea 36 (1869) 67.

Palmer River, alt. 100 m, *Brass 7167;* Kari Mts., alt. 1,000 m, *Schlechter 17198.*

BORNEO; MALAYA.

Not certainly distinct from *S. pusillum.*

S. pusillum may be represented by *Brass 9329,* Lake Habbema, alt. 3,225 m, on rocks in grassland; a dwarfed plant.

2. **S. JUNCIFOLIUM** Copel., sp. nov.

S. rhizomate adscendente, paleis fuscis, minutis; frondibus dense fasciculatis, usque ad 12 cm longis, 1–1.8 mm latis, apiculatis, deorsum usque ad rhizoma attenuatis, coriaceis, parte fertile subapicale 2–5 cm longa 2–2.5 mm lata, soro fere marginale.

Brass 11864, type, SW. of Bernhard Camp, Idenburg River, alt. 1,800 m; *No. 12602,* alt. 2,150 m; common on branches of tall trees. Here probably belongs also *Clemens 41006,* Matap, Morobe District, alt. 5,000 to 6,000 feet; smaller than type, with more dilated fertile portion.

I propose a new name reluctantly, in this genus of dubious species, but the plants seem really distinct. *S. pusillum,* as represented by my own collection on the Gedeh (type locality), has less closely marginal sori, and non-dilated fertile portion of the frond. The closest resemblance of the new species is to *S. minus* (Fée) C. Chr., common in the Philippines and ascribed to Amboyna by Christensen, also with hardly dilated fertile portion.

S. juncifolium may possible be *Pleurogramme loheriana* var. *novoguineensis* Ros., Nova Guinea 8 (1912) 729, and/or *Scleroglossum pusillum* var. *novoguineense* v.A.v.R., Malayan Ferns Suppl. (1917) 340. Christensen construes these as *S. pusillum* var. *angustissimum* (Copel.) C. Chr. *S. juncifolium* is positively not *S. angustissimum.*

3. TAENITIS SIMPLICIVENIA Cesati

Taenitis simplicivenia CESATI, Rend. Acad. Napoli 16 (1877) 30.

Christensen did not transfer this specific name, regarding it as a synonym of *S. pusillum*. He says, page 27, "*Taenitis simplicivenia* and *Monogramma intermedia* Cop.... are very nearly identical." As he, and nobody else, has seen both of these, I accept his statement, and identify as this species.

King 371, from Papua.

Range in doubt, since I do not believe my *M. intermedia* is *S. pusillum*.

3. XIPHOPTERIS Kaufuss

Key to the species

Sporangia on entire apical portion of fronds..... 1. *X. antipodalis*
Sori on lateral segments or pinnae.
  Not glandular-pubescent.
    Pinnatifid (not cut to the rachis).
      Subcoriaceous or papyraceous.
        Lamina glabrescent ..... 2. *X. subpinnatifida*
        Lamina hairy.
          Fertile lobes quadrangular ..... 3. *P. pumilum*
          Lobes roundish or triangular ..... 4. *P. sepikense*
      Coriaceous ..... 5. *X. govidjoaense*
    Pinnate.
      Fronds up to 4 cm long ..... 6. *P. musbravianum*
      Fronds over 10 cm long.
        Fronds glabrous ..... 7. *X. conjunctisorum*
        Fronds pilose ..... 8. *P. Pullei*
  Glandular-pubescent ..... 9. *X. glanduloso-pilosum*

1. XIPHOPTERIS ANTIPODALIS Copel. **Plate 1a**

X. antipodalis COPEL., U. C. Publ. Bot. 18 (1942) 224.

Rhizomate breve, erecto, paleis ferrugineis lanceolatis ca. 2 mm longis, apice breviter setuliformabus vestito; stipitibus fasciculatis, 5 mm longis, frondibusque setis castaneis 1 mm longis sparsis; fronde 10 cm longa, 2–3 mm lata, apice caudata, deorsum sterile pinnata, pinnis 1 mm longis vix 0.3 mm latis rigidis monophlebiis, rhachi inconspicue decurrenti-alata, surnis hujus partis frondis furcatis; soris costam secus confluentisum subito fertile haud pinnata, lateribus deflexis dentatis, venis hujus partis frondis furcatis; soris costam secus confluenticontinuis, sporangiis nudis, cellulis annuli ca. 12.

DUTCH NEW GUINEA: 9 km. N. E. of Lake Habbema, alt. 2,800 m, *Brass 10788*, "tufted on mossy trunks of trees, uncommon."

2. XIPHOPTERIS SUBPINNATIFIDA (Blume) Copel.

X. subpinnatifida (Blume) COPEL., Genera (1947) 215.
Polypodium subpinnatifidum BLUME, Enum. (1828) 129.

Not previously reported from New Guinea, but I so determine two specimens sent by Mrs. Clemens from Mt. Sarawaket, alt. 8,000 to 11,000 feet.

To Luzon (Philippines), Malacca, Java.

3. POLYPODIUM PUMILUM Brause

P. pumilum BRAUSE, Engl. Jahrb. 49 (1912) 38, *fig. 2 F.*

Finisterre Mts., alt. 1,250 m, *Schlechter 19112,* sole collection.

4. POLYPODIUM SEPIKENSE Brause

P. sepikense Brause, Engl. Jahrb. 56 (1920) 182.

Sepik region, alt. 400 m, *Ledermann 7602,* sole collection.

5. XIPHOPTERIS GOVIDJOAENSIS (Brause) Copel.

X. *govidjoænsis* (Brause) COPEL., Genera (1947) 215.
Polypodium govidjoænse BRAUSE, Engl. Jahrb. 49 (1912) 41, *fig. 2 K.*

GERMAN NEW GUINEA, alt. 1,200 m, *Schlechter 19747; Clemens 12296.*

Endemic.

6. POLYPODIUM MUSGRAVIANUM Baker

P. musgravianum BAKER, Journ. Bot. 28 (1890) 108.

Mt. Musgrave, *MacGregor,* sole collection.

7. XIPHOPTERIS CONJUNCTISORUM (Baker) Copel., comb. nov.

Polypodium conjunctisorum, Annals Bot. 8 (1894) 129.

Mt. Suckling, *MacGregor;* Amieng, Morobe, alt. 5,000 to 6,000 feet, *Clemens 12032, 12251.*

In the description of *P. pseudo-spirale* v.A.v.R., Bull. Jard. Buit. II No. 1 (1911) 29, I find nothing against the author's suggestion that it may be *P. conjunctisorum.* Christensen and van Alderwerelt agreed in reducing to it *P. roemerianum* Ros., Nova Guinea 8 (1912) 725, which is described as having dark setae on its rachis.

8. POLYPODIUM PULLEI Alston

P. Pullei ALSTON, Jour. Bot. 78 (1940) 229.

DUTCH NEW GUINEA, Bijenhorfbivak, alt. 1,800 m, *Pulle 765.*

Known by a single collection.

Species nos. 3, 4, 6, and 8 are unknown to me, and I have no opinion as to their distinctness. The key indicates the supposed differences.

9. XIPHOPTERIS GLANDULOSO-PILOSA (Brause) Copel.

X. glanduloso-pilosa (Brause) COPEL., Genera (1947) 215.
Polypodium glanduloso-pilosum BRAUSE, Engl. Jahrb. 56 (1920) 181.

GERMAN NEW GUINEA, *Ledermann 8492*, type; *Schlechter 14469;* Central Division, *Brass 4586,*—see Christensen, Brittonia 2 (1937) 307; *Clemens s. n.;* DUTCH NEW GUINEA, *Brass 12606, 12689*, alt. 2,150 m.

Endemic.

Brass 12606 is a very small plant, even smaller than the described type. *No. 4686* is larger, with single acroscopic teeth on the larger segments. *No. 12589* has fronds 15 cm long, with longer narrow segments hardly connected along the rachis, sometimes with two sub-segments. The pubescence of all is identical; I have little doubt that they represent one species, although *Nos. 12606* and *12689* differ widely in appearance.

4. CALYMMODON Presl

Key to the species

Dark binate bristles present, veins forked.
  Sterile lamina crenate-dentate ..... 1. *C. grammitidiphyllum*
  Sterile lamina practically pinnate ..... 2. *C. kaniensis*
Dark solitary hairs present ..... 3. *C. conduplicatus*
Hairs pale, tawny or none.
  Fertile segments or pinnae fully adnate.
    Fronds 3–6 mm wide ..... 4. *C. cucullatus*
  Fertile pinnae contracted toward rachis.
    Fronds under 2 mm wide ..... 5. *C. pergracillimus*
  Fertile pinnae partly adnate or sessile.
    Sterile pinnae obliquely deltoid ..... 6. *C. atrichus*
    Sterile pinnae oblong.
      Fronds thin.
        Frond 2–4 mm wide.
          Frond lax, over 10 mm long..... 7. *C. ramifer*
          Frond up to 3 mm long ..... 8. *C. congestus*
        Frond 7 to 10 mm wide ..... 9. *C. mnioides*
      Frond thick but brittle ..... 10. *C. fragilis*
Fertile pinnae narrowly stalked ..... 11. *C. clavifer*

1. CALYMMODON GRAMMITIFIPHYLLUS Copel. **Plate 1b.**

C. grammitifiphyllus COPEL., U. C. Publ. Bot. 18 (1942) 224.

Caudice erecto, paleis atrocastaneis linearibus 5 mm longis apicibus setoso-protractis vestito; frondibus fasciculatis, sessilibus, usque ad 30 cm longis, 4–8 mm latis, deorsum subattenuatis, basi imo integris alibi crenato-dentatis, supra medium fertilibus dentibus soriferis plerisque majoribus oblongis, setulis

atropurpureis fasciculatis minutis plus minus deciduis sparsis, carnosis; costa immersa, venis occultis, angulo acuto divergentibus, furcatis; lobis fertilibus more generis conduplicatis, venula in lobo simplice, sporangiis nudis.

DUTCH NEW GUINEA; 2 km. SW. of Bernhard Camp, Idenburg River, alt. 750 m, *Brass 13443;* "Rain-forest; in moss on branches of tall trees."

Vegetatively, this is a *Grammitis,* but the conduplicate fertile lobes demand its inclusion in *Calymmodon.*

2. CALYMMODON KANIENSIS (Brause) Copel.

C. kaniensis (Brause) COPEL., Genera (1947) 216.
Polypodium kaniense BRAUSE, Engl. Jahrb. 49 (1912) 40, *fig. 2 H.*

Schlechter 17247, isotype in Herb. Univ. Calif.; *Brass 13789, 12828,* 6 km SW. of Bernhard Camp, Idenburg River, alt. 1,200 m.

Requiring amendment of my generic description, Philip. Jour. Sci. 34 (1927) 259, the veins of both sterile and fertile pinnae are likely to be forked. This raises no question as to its being a *Calymmodon,* to which affinity Brause correctly assigned it. Construing *Calymmodon* as a derivative of *Grammitis* or *Xiphopteris,* the fertile veins of which are almost always forked, this peculiarity may mark the species as relatively primitive in the genus. The pubescence is equally novel in the genus, though now known in the preceding species also. Brause says: "Foliis . . . juventute supra margineque pilis brunneis e basi furcatis armata." Some setae are solitary, more are binate, some are as many as four in a cluster, a few are forked above the base. Rather dark binate hairs are not rare in *Grammitis.*

Polypodium sclerophylum v.A.v.R., Nova Guinea 14 (1924) 45. Mamberamo River, alt. 210 m, *Lam 827,* is described as having deeply pinnatifid fronds 2.5 to 5.0 cm long, bearing solitary and fascicled castaneous setulae. As some of the segments are emarginate, it may be presumed that some of the veins are forked. It must be a diminutive *C. kaniensis* or a closely related dwarf species.

3. CALYMMODON CONDUPLICATUS (Brause) Copel.

C. conduplicatus (Brause) COPEL., Philip. Jour. Sci. 34 (1927) 268.
Polypodium conduplicatum BRAUSE, Engl. Jahrb. 49 (1912) 41, *fig. 2 J.*

GERMAN NEW GUINEA, Bismarck Mts.; Morobe, *Clemens 11941 partim.*

This is a dwarf, but bears peculiar hairs which bar its identification as any known species of more normal size.

4. CALYMMODON CUCULLATUS (N. & B.) Presl

C. cucullatus (N. & B.) PRESL, Tent. (1836) 204.
Polypodium cucullatum N. & B., Nova Acta 11 (1823) 121, *pl. 12, fig. 3.*

Lake Habbema, alt. 3,225 m, *Brass 9374;* alt. 2,800 *m, Brass 10789;* Morobe, *Clemens 11941 partim.*

Malaya; to Luzon.

C. hygroscopicus Copel., Philip. Jour. Sci. 34 (1927) 265, *pl. 5,* now seems hardly distinguishable from *C. cucullatus.*

5. CALYMMODON PERGRACILLIMUS (v.A.v.R.) Copel.

C. pergracillimus (v.A.v.R.) COPEL., Philip. Jour. Sci. 34 (1927) 263, *pl. 1.*

POLYPODIUM PERGRACILLIMUM v.A.v.R.

P. pergracillimum v.A.v.R., Bull. Jard. Buit. II No. XX (1915) 23.

This has never been adequately described from authentic specimens. It was based on *v. Roemer 1220* and *1342,* from the Hellwig Mountains and Wilhelmina-Top. With these, I have identified a collection by Boden-Kloss from Camp XIII of the Wollaston Expedition, and it is by this that I know the species, if at all. It is characterized by extreme slenderness, and by the reduction of the fertile "pinnae" to minute, obliquely deltoid teeth. It is near the slender form of *C. cucullatus,* but well beyond the range of variation credited to that species.

I now rename or describe three additional species, all from one of the original localities of *C. pergracillimus,* and all, however different in appearance, its near relatives. Even knowing the variability of *C. cucullatus,* I do not recognize any of these as probably identical with *C. pergracillimus;* but there may be plasticity here beyond my understanding. *C. atrichus* and *C. fragilis* are very different in texture as well as in form.

6. CALYMMODON ATRICHUS Copel., nom. nov.

Polypodium pendens C. Chr., Brittonia 2 (1937) 306, *non* Ros.

Brass 5253 (type) *4484,* cited by Christensen; *11865,* Idenburg River region, alt. 1,800 m. Exceedingly like *C. kaniensis* in gross appearance, distinguished by the absence of hairs and the uniformly unforked veins; correlated with the latter, the fertile pinnae are entire. The paleae of *No. 11865* are dark, like those of *C. kaniensis.*

7. CALYMMODON RAMIFER Copel. **Plate 2.**

C. ramifer COPEL., U. C. Publ. Bot. 18 (1942) 224.

C. paleis rhizomatis 1.5 mm longis (typi) lanceolatis, vel 4 mm longis lineari-lanceolatis, brunneis; stipite breve rhachique

filiformibus anguste alatis; fronde ca. 20 cm longa, 2–4 mm lata, pinnis sterilibus obliquis, ca. 2 mm longis, 0.7 mm latis, decurrentibus, tenuiter herbaceis, glabris, fertilibus aequilongis latioribus, carinato-conduplicatis, apud rhachin contractis, decurrenti-adnatis.

DUTCH NEW GUINEA; *Brass* and *Myer–Drees 9943 A, type,* 7 Km NE. of Wilhelmina-Top, alt. 3,720 m, in subalpine forest, fronds mostly two or three times forked, forming pendent tufts like a *Lycopodium,* stipes numerous and paleae small; *No. 9616,* alt. 3,560 m, likewise forked, stipes few and paleae large; *No. 10307,* alt. 3,800 m, fronds not forked.

8. CALYMMODON CONGESTUS Copel., sp. nov.

C. minimus; paleis rhizomatis 1–1.5 mm longis castaneis; frondibus confertissimis, usque ad 3 cm longis, 2–3 mm latis, tenuiter herbaceis, glabris, rhachi deorsum vix alata; segmentis fertilibus late ovatis, contiguis vel subimbricatis, ad rhachin anguste decurrentibus, sterilibus haud remotis, ellipticis, ca. 0.5 mm latis.

Rawlinson Range, alt. 21,000 feet. *Clemense s. n., anno* 1941.

9. CALYMMODON FRAGILIS Copel. Plate 3.

C. fragilis COPEL., U. C. Publ. Bot. 18 (1942) 224.

C. paleis rhizomatis 1.5–2.0 mm longis, lanceolatis, fuscis; stipitibus subnullis vel usque ad 2 cm longis, dense fasciculatis; frondibus 10–25 cm longis, 4–5 mm latis, fragilibus, rhachi gracile anguste alata, pinnis paucis infimis plerisque 2 mm longis, 0.6 mm latis, saepe recurvis, carnosis, glabris; pinnis fertilibus numerosissimis, patentibus, 2 mm longis, etenim conduplicatis 1 mm latis ovatis, acutis, apud rhachin contractis, adnatis.

DUTCH NEW GUINEA; *Brass* and *Myer–Drees 10035, type,* 2 km E. of Wilhelmina-Top, alt. 3,800 m, "Commonest epiphyte in subalpine forest"; *No. 9943,* alt. 3,720 m.

Remarkable for its thick, fragile fronds, fertile almost to the base.

10. CALYMMODON MNIOIDES Copel.

C. mnioides COPEL., Philip. Jour. Sci. 34 (1927) 261, *pl. 6.*
Polypodium persimile C. CHR., Brittonia 2 (1937) 307, *non* Baker.

Kani Range, alt. 1,000 m, *Schlechter 17200; Brass 4581,* cited by Christensen; *11862,* Idenburg River region, alt. 1,800 m. The fronds of the Brass collections run about 10 cm long, in contrast with the 2 to 3 cm ascribed to *C. mnioides,* but I find no more dependable specific differences. The type may be presumed to consist of old plants, as indicated by the dense

mass of stipe-bases, and dwarfed in senescence. Christensen's description applies to the plant in normal development, fronds up to 12 cm long. I have not seen *Brass 4662*, the type of *B. persimilis*.

11. CALYMMODON CLAVIFER (Hooker) Moore

C. clavifer (Hooker) MOORE, Index (1861) 219.
Polypodium clavifer HOOKER, Sp. Fil. IV (1862) 176.

Brass 10254, 11039, 11238, 18705, 13298, alt. 900 to 2,800 m; previously known by several New Guinea collections. A variable but well characterized species.

MINDANAO; BORNEO.

5. ACROSORUS Copeland

Acrosorus Schlechteri CHRIST, Geog. d. Farne (1910) 232.
Prosaptia Schlechteri CHRIST, Nachtr. Fl. Deut. Schutzgeb. Südsee (1905) 41, *pl. I B.*
Davallia Schlechteri C. CHR., Index (1905) 663.
Polypodium Schlechteri v.A.v.R., Malayan Ferns (1909) 614.

First collected by Schlechter; later, three times, by Ledermann Sepik region, alt. 850 to 1,500 m.

Endemic, with near relatives in Samoa, and westward to Malacca.

6. CTENOPTERIS Blume

Key to the species

Pinnae or segments entire or crenate.
  Fronds thin or soft and fleshy, hairy.
    Fronds lobed or pinnatifid.
      Fronds under 1 cm wide ..... 1. *C. bolobensis*
      Fronds 2.5 to 6.0 cm wide ..... 2. *C. geluensis*
    Fronds pinnate.
      Pinnae broadly linear ..... 3. *P. pensile*
      Pinnae obliquely oblong.
        Pinnae acute ..... 4. *C. beleensis*
        Apex of pinnae rounded ..... 5. *C. micropaleata*
  Fronds more or less coriaceous.
    Sori superficial.
      Paleae not described, presumably inconspicuous or none ..... *P. politum*
    Paleae entire.
      Fronds under 1 cm wide.
        Pinnae linear ..... 6. *P. Macgregori*
        Segments oblong or roundish ..... 7. *C. pycnophylla*
      Pinnae more than 5 mm long.
        Rigidly coriaceous, pinnae dentate.
          Deeply pinnatifid ..... 8. *C. denticulata*

- Pinnate or nearly so.
  - Pinnae decurrent.
    - Pinnae oblong ..... 9. *C. undosa*
    - Pinnae lanceolate ..... 10. *C. bolanica*
  - Pinnae dilated rather than decurrent ..... 11. *C. solida*
- Less rigid, pinnae mostly entire.
  - Veinlets simple.
    - Reduced basal pinnae many..... 16. *C. integripaleata*
    - Reduced basal pinnae few.
      - Lower pinnae abruptly reduced 13. *C. Curtisii*
      - Lower pinnae gradually reduced.
        - Frond at least 30 cm long.... 15. *P. ctenoideum*
        - Frond smaller.
          - Frond caudate ..... 14. *C. longiceps*
          - Frond not caudate ..... 12. *C. inconspicua*
  - Veinlets forked.
    - Segments acute ..... 17. *C. schizophlebia*
    - Segments obtuse ..... 18. *C. Clemensiae*
- Paleae ciliate.
  - Pinnae standing flat.
    - Pinnae narrowly linear, acute, horizontal ..... 24. *C. subulatipinna*
    - Pinnae linear, acute, ascending ..... 25. *C. rawlinsonensis*
    - Pinnae broader, obtuse.
      - Axes moderately hairy or glabrescent.
        - Pinnae remote, confluent ..... 22. *C. pendens*
        - Pinnae closer, not confluent..... 19. *C. nutans*
        - Pinnae contiguous, narrowly confluent.
          - Stipe short, naked ..... 20. *C. rhodocarpa*
          - Stipe setose ..... 21. *C. pubipes*
      - Axes densely hairy ..... 23. *C. whartoniana*
  - Pinnae folded upward back to back.... 26. *C. fusca*
- Sori impressed or immersed.
  - Paleae entire.
    - Sori oblong, parallel to costa ..... 27. *C. blechnoides*
    - Sori round or oblique.
      - Pinnae entire ..... 28. *P. flagelliforme*
      - Pinnae crenate ..... 29. *C. repandula*
  - Paleae ciliate.
    - Frond 1 to 3 cm wide ..... 30a. *P. cryptosorum*
    - Frond wider.
      - Sori not conspicuously oblique.
        - Rim of soral pits low.
          - Sori medial.
            - Costa glabrescent ..... 30. *C. celebica*
            - Costa binate-bristly ..... 31. *C. stellatosetosa*

Sori subcostal ..... 32. *P. rachisorum*
Rim high, very conspicuous.
Pinnae confluent ..... 33. *C. Ledermanni*
Pinnae not confluent.
Sori round ..... 34. *C. Brassii*
Sori oblong ..... 35. *C. venulosoides*
Sori oblique to costa.
Rim of soral pit not raised. 37. *C. Shawii*
Rim moderately raised.
Frond 4 to 6 cm wide ..... 36. *C. obliquata*
Frond 8 cm wide ..... 38. *C. multicaudata*
Rim very conspicuous ..... 39. *C. circumvallata*
Pinnae deeply toothed or more dissected.
Pinnae mostly uncut on basiscopic side..... 47. *C. subsecundo-dissecta*
Pinnae cut on both sides.
Pinnae merely toothed.
Fronds clustered ..... 40. *C. congregatifolia*
Fronds remote ..... 41. *C. allocota*
Pinnae pinnatifid or pinnate
Rachis firm.
Veins of primary pinnules simple.
Sori basal on pinnules.
Rachis densely red-hairy ..... 42. *C. eximia*
Hairs less dense and less red..... 43. *C. tenuisecta*
Sori distal on pinnules.
Pinnules naked ..... 44. *C. taxodioides*
Few long setae present ..... 45. *C. Yoderi*
Secondary costae pinnate ..... 46. *C. millefolia*
Rachis weak and flexuose.
Secondary rachises evidently winged.
Lamina glabrescent ..... 48. *C. sesquipinnata*
Lamina hairy.
Axes moderately hairy ..... 49. *C. bipinnatifida*
Axes densely hairy ..... 50. *C. polytricha*
Secondary rachises barely winged ..... 51. *C. bipinnata*

1. **CTENOPTERIS BOLOBENSIS (Brause) Copel., comb. nov.**

Polypodium bolobense BRAUSE, Engl. Jahrb. 49 (1912) 38, *fig. 2 E.*

GERMAN NEW GUINEA, near Bolobo, alt. 350 m, *Schlechter 16522;* isotype in Herb. Univ. Calif.

2. **CTENOPTERIS GELUENSIS (Ros.) Copel., comb. nov.**

Polypodium geluense ROS., Fedde's Repert 5 (1908) 374.

Gelu Mountain, alt. 1,000 m, *Werner 45,* isotype in Herb. Univ. Calif.; Sattelberg, alt. 1,600 m, *Keysser 10;* Ins. Rook, alt. 200 m, *Bamler R 26* (not typical); DUTCH NEW GUINEA, Idenburg River, alt. 850 m, *Brass 13207.*

Endemic.

3. POLYPODIUM PENSILE Ridley

P. pensile RIDLEY, Trans. Linn. Soc. Bot. II 9 (1916) 262.

Wollaston Exped., Camps IX to X, alt. 5,500 to 6,700 feet. Said to be hairy, pendulous, "of an almost fleshy nature," but near to *P. celebicum* Blume; it may be misplaced here.

4. CTENOPTERIS BELEENSIS Copel.

C. beleensis COPEL., U. C. Publ. Bot. 18 (1942) 225, *pl.*

Rhizomate erecto, breve, (paleis paucis stramineis 0.5 mm longis vestito); stipite 3 cm longo rhachique filiformibus, laminaque ubique pilis albidis fulvescentibus 1–3 mm longis dense lanosis; lamina 40 cm longa, 15 mm lata, flexile, pendente, deorsum (basin versus) attenuata, pinnata; pinnis triangulari-oblongis, 7–9 mm longis, basi 4 mm latis obliquis acroscopice dilatatis et semi-adnatis, vix decurrentibus, acutis vel obtusis, herbaceis; vena prima acroscopica interdum furcata caeteris simplicibus brevibus luce transmissa conspicuis; soris superficialibus, orbicularibus, ad venas terminalibus.

DUTCH NEW GUINEA, Bele River, alt. 2,200 m, *Brass 11041;* rare low epiphyte in tall forest. My observation as to the paleae may not be trusted, because made on a very young plant, not the source of the frond described.

5. CTENOPTERIS MICROPALEATA Copel.

C. micropaleata COPEL., Genera (1947) 219.
Polypodium rufescens BRAUSE, Engl. Jahrb. 49 (1912) 43, *non Ctenopteris rufescens* KUNZE.

Type, not seen, *Schultze 822,* from German New Guinea; Dutch New Guinea, *Brass 12623, 12639, 12834,* alt. 2,150 and 1,200 m. These Brass specimens agree with the description except that the fronds vary from obtuse to acute, and the pinnae are obtuse or rounded. Brause is silent as to the paleae; they exist, but only as ciliate vestiges, the suppression being like that familiar in *Grammitis* under the same conditions.

6. POLYPODIUM MACGREGORI Baker

P. Macgregori BAKER, Annals Bot. 8 (1894) 130.

ROSSEL ISLAND. Not seen and not comprehended; said to have fronds 6 to 8 inches long, 3 to 4 lines wide, and linear pinnae, with superficial sori "utrinque costam uniseriatis," and to be near to *P. blechnoides* Hooker.

7. CTENOPTERIS PYCNOPHYLLA (C. Chr.) Copel., comb. nov.

Polypodium pycnophyllum C. CHR., Brittonia 2 (1937) 308.

Mt. Albert Edward, alt. 3,680 m, *Brass 4421.*

8. CTENOPTERIS DENTICULATA (Blume) Copel., comb. nov.

Grammitis denticulata BLUME, Flora Javae (1828) 121, *pl. 50, fig. 4.*

Reported from New Guinea by Brause,—*Ledermann 11710, 12070.*

JAVA; SUMATRA.

9. CTENOPTERIS UNDOSA (Baker) Copel., comb. nov.

Polypodium undosum BAKER, Jour. Bot. 28 (1890) 108.

Type from Mt. Musgrave, *1. Macgregor;* said to be near *Polypodium Grammitidis* R. Br. Known to me by *Brass 4254, 4255* from Mt. Albert Edward, alt. 3,630 m, det. Christensen.

10. CTENOPTERIS BOLANICA (Ros.) Copel., comb. nov.

Polypodium solidum var. *bolanica* Ros., Fedde's Repert. 12 (1913) 177.

P. bolanicum COPEL., U. C. Cont. Bot. 12 (1931) 403.

Bolan, alt. 3,490 to 3,800 m, *Keysser;* isotype in Herb. Univ. Calif.

11. CTENOPTERIS SOLIDA Kunze

C. solida KUNZE *apud.* Zoll., Syst. Verz. (1854) 37.

Brass 9174, 11031, 11851, 12605, alt. 2,150 to 3,225 m; known throughout New Guinea, and to Mindanao and Java.

Construing this species broadly in New Guinea, I probably include *Polypodium vernicosum* v.A.v.R., Nova Guinea 14 (1924) 48, typified by *Lam 1797,* Doorman-Top, alt. 3,200 m, which I have not seen.

The preceding five species are a natural group, to which *C. allocota* (No. 41) and some other more dissected species are closely related.

12. CTENOPTERIS INCONSPICUA (Blume) Copel., comb. nov.

Polypodium inconspicuum BLUME, Enum. (1828) 130.

Known in New Guinea only by a report by Ridley. It is a diminutive relative, possibly a diminutive form, of *C. Curtisii,* and has the far older name.

13. CTENOPTERIS CURTISII (Baker) Copel., comb. nov.

Polypodium Curtisii BAKER, Jour. Bot. 19 (1881) 367.

P. decrescen CHRIST, Ann. Jard. Bot. Buit. II 4 (1904) 35.

Reported from the Arfak Mts., *1 Gibbs.*

LUZON; SUMATRA.

14. CTENOPTERIS LONGICEPS (Ros.) Copel., comb. nov.

Polypodium longiceps Ros., Fedde's Repert. 12 (1913) 177.

Bolan, alt. 2,400 to 3,000 m, *Keysser II 72;* isotype in Herb. Univ. Calif.

15. POLYPODIUM CTENOIDEUM Brause

P. ctenoideum BRAUSE, Engl. Jahrb. 56 (1920) 188.

GERMAN NEW GUINEA, alt. 2,000 to 2,500 m, *Ledermann 11709, 12071a, 12131a,* not seen. Paleae with "margine subintegro"; stipes articulate, glabrescent. Said to be a relative of *C. celebica.*

16. CTENOPTERIS INTEGRIPALEATA Copel. **Plate 4a.**

C. integripaleata COPEL., U. C. Publ. Bot. 18 (1942) 225.

Rhizomate brevi-repente, valido, paleis integris castaneis lanceolatis 6 mm longis et ovatis brevioribus vestito; stipitibus ca. 4 mm inter se remotis, non articulatis, infra rudimenta pinnarum 2–5 cm altis, 1.5–2.0 mm crassis, deorsum paleatis, alibi pilis castaneis fragilibus usque ad 1 mm longis inconspicuis sparsis; lamina ca. 30 cm alta, 4–5 cm lata, breviter caudata, fere ad rhachin pinnatifida, deorsum sat abrupte contracta, pinnis infimis ca. 10-paribus ad vestigia 4 mm lata minusquam 1 mm longa sensim evanescentia reductis, rhachi superne sulcata inferne terete sparse decidue puberula; pinnis subhorizontalibus, 2–3 cm longis, ca. 2.5 mm latis, spatio aequilato separatis, rectis, integris, basi anguste confluentibus, sparsissime decidue setoso-ciliatis aliter glabris, fusco-viridibus, coriaceis; venis immersis, inconspicuis, *fertilibus furcatis;* soris superficialibus, orbicularibus, costalibus, usque ad 12-paribus, sporangiis nudis.

DUTCH NEW GUINEA: 15 km. SW. of Bernhard Camp, Idenburg River, *Brass 12249* type, alt. 1,800 m; low tuft epiphyte in mossy forest; *No. 12376,* alt. 1,500 m, on a high mossy branch in the rain forest.

Near to *Polypodium ctenoideum* Brause as judged by description, but the stipes not articulate, and apparently different in minor details. Distinguished from *C. nutans* by entire paleae. Paleae on the base of the stipe are rare throughout this family, but are known, and equally rare, in *Grammitis.*

17. CTENOPTERIS SCHIZOPHLEBIA Copel.

C. schizophlebia COPEL., U. C. Publ. Bot. 18 (1942) 225.

Rhizomate brevi-repente, paleis brunneis late lanceolatis 2 mm longis integris vestito; stipitibus approximatis, usque ad 10 cm longis, gracilibus, fuscis, setis obscurioribus 2 mm longis sparsis; lamina 15–25 cm longa, 6 cm lata, caudata, ad basin aut truncata aut abrupte et breviter angustata, pinnatifida, papyracea, ad marginem costamque immersam setis paucis ornata; segmentis e basibus 4–5 mm latis ad apices acutas

sensim angustatis, plerisque subfalcatis, integris; venis plerisque furcatis; soris inframedialibus, ad venas acroscopicas fere basalibus, superficialibus.

NEW GUINEA: Morobe: Amieng, alt. ca. 1,800 m, in montane bush. *M. S. Clemens*, May, 1941.

In aspect of frond, there is resemblance to the Bornean *Polypodiopteris proavita*, but there is no affinity.

18. CTENOPTERIS CLEMENSIAE Copel. Plate 4b.

C. Clemensiae COPEL., U. C. Publ. Bot. 18 (1942) 225.

Rhizomate repente, 2–3 mm crasso, paleis ovatis brunneis integris vestito; stipitibus approximatis, 10 cm longis, gracilibus, fuscis, setis obscurioribus 1.5 mm longis ornatis; lamina 15–20 cm longa, 5 cm lata, brevi-caudata, basi truncata vel pinna una vestigiale sustensa, pinnatifida, carnoso-coriacea, costa immersa margineque decidue setosis; segmentis oblongo-linearibus, obtusis vel rotundatis, 3–4 mm latis, integris; venis furcatis; soris inframedialibus, ad venulas acroscopicas basalibus, superficialibus, sporangiis nudis.

NEW GUINEA: Morobe: Amieng, alt. ca. 1,800 m, in montane bush. *M. S. Clemens*, 1941.

Both this and the preceding species reach me in mixtures with various other ferns. They are related, but very distinct in appearance, chiefly because of the shape of the segments. Forked veinlets are most unusual in *Ctenopteris*,—are excluded, in fact, by the original definition; still, I feel sure that this is where these species belong. Affinity to *Polypodium Grammitidis*, also with forked veins and broad, entire paleae, is probable. *Polypodium flavovirens* Alston, Journal of Bot. 78 (1940) 228, seems to have forked veins, but to be distinct in several other respects; I have not seen it. *Polypodium Clemensiae* is a *Crypsinus*.

19. CTENOPTERIS NUTANS (Blume) J. Sm.

C. nutans (Blume) J. SM., Hist. Fil. (1875) 185.
Polypodium nutans BLUME.

Brass 9218, alt. 3,225 m, Lake Habbema, and *10302 A*, alt. 3,800 m; typical except that the stipes bear a few longer setae among the very short ones, and are presently glabrescent.

C. nutans var. *trichocarpa* Ros., Fedde's Repert. 10 (1912) 339, Sattelberg, alt. 900 m, *Bamler S 58*, is distinguished by reddish-brown hairs in the sori,—a most remarkable peculiarity.

Mrs. Clemens has sent from Morobe "Upper Camp," alt. 8,000 to 9,000 feet, an undescribed plant near *C. nutans,* with more conspicuously hairy stipes.

20. CTENOPTERIS RHODOCARPA Copel.

C. rhodocarpa COPEL., U. C. Publ. Bot. 18 (1942) 225.

C. gregis C. nutantis, rhizomate breve, 4 mm crasso, paleis fuscis linearibus plerisque 6 mm (rarius usque ad 9 mm) longis ciliatis immerso; stipitibus approximatis, 1.5–3 cm longis, fuscescentibus, mox glabrescentibus; lamina usque ad 25 cm longa, 4 cm lata, caudata, deorsum angustata, fere ad costam pinnatifida, coriacea, glabra siccitate recurva, segmentis subhorizontalibus, obtusis, integris, costam prope leviter dilatatis confluentibus, alibi 2.5 mm latis; venis simplicibus, confertis; soris inframedialibus, usque ad 17-paribus, superficialibus, primo roseis tum demum fuscescentibus, sporangiis nudis.

NEW GUINEA: Morobe: Amieng, alt. ca. 1,800 m, in montane bush. *M. S. Clemens,* March, 1941.

In aspect, between C. *nutans* and *C. pendens,* the segments being close (as in *C. nutans*), but confluent; more naked than either, and unlike both in the very close and numerous veins.

21. CTENOPTERIS PUBIPES Copel. Plate 5a.

C. pubipes COPEL., U. C. Publ. Bot. 18 (1942) 225.

C. rhodocarpae similis, stipitibus setis 1–2 mm longis fuscis persistentibus ornatis, etiam costa sparse pubescente distincta; paleis usque ad 11 mm longis; lamina 15 cm longa, 15–18 mm lata, profunde pinnatifida; venis ca. 7-paribus non confertis.

NEW GUINEA: Morobe: "Upper Camp," alt. ca. 2,500 m. *M. S. Clemens,* March, 1939.

This is like *C. rhodocarpa* in the close, confluent segments.

Polypodium abebaion v.A.v.R., Nova Guinea 14 (1924) 45, is described from a monstrosity, *Lam 1508,* Doorman-Top, alt. 1,420 m, with segments very irregular in length. It has pale, entire paleae, pubescent stipes, fronds pinnatifid to a broad wing, coriaceous, entire segments, glabrous except for marginal setulae, and practically superficial sori. I have not seen it, and cannot associate it, by description, with any species with normal fronds.

22. CTENOPTERIS PENDENS (Ros.) Copel., comb. nov.

Polypodium pendens Ros., Fedde's Repert. 12 (1913) 177.

Bolan, alt. 2,400 to 3,000 m. *Keysser B 86,* isotype in Herb. Univ. Calif.; Dutch New Guinea, *Brass 9300, 9301, 9465, 9467, 9469, 9856, 11070, 11431,* alt. 2,200 to 3,560 m. The

variability explains the number of collections. *Nos. 11070* and *11431* have the axes almost glabrous; on the others, these are more hairy than on our isotype. *No. 9469,* in full fruit, has fronds only 15 cm long.

23. CTENOPTERIS WHARTONIANA (C. Chr.) Copel., comb. nov.

Polypodium whartonianum C. Chr., Brittonia 2 (1937) 309.

Brass 9468, 9470, Brass and *Myer-Drees 9764, 9895,* alt. 3,225 to 2,650 m, epiphytic in mossy and subalpine forest. The original collection is *Brass 4631,* Central Division, alt. 2,840 m.

If my identification is correct, as to which I have little doubt, the type collection was not typically developed. All of the Lake Habbema-Mt. Wilhelmina specimens are decidedly more hairy than the original, rather more coriaceous and elastic-curving, and with the veins more conspicuous on the upper surface. These are differences of degree only, the original being described as "dense hirtis." The veins, described as indistinct, are really quite manifest on the New York isotype, but not conspicuous as in the four new collections. The hairs, seen in mass by light reflected at a broad angle, are a remarkably fine cinnamon-red.

24. CTENOPTERIS SUBULATIPINNA (v.A.v.R.) Copel., comb. nov.

Polypodium subulatipinnum v.A.v.R., Nova Guinea 14 (1924) 46.

Brass 11034, Bele River, alt. 2,200 m, occasional on mossy trunks; *11850,* Lake Habbema, alt. 3,225 m. The type is *Lam 1781,* foot of Doorman Summit, alt. 3,200 m. I have not seen this, and, not being quite certain of the identification, will describe Brass' plants:

Rhizomate brevi-repente, 4 mm crasso, paleis ciliatis fragilibus deciduis vestito; stipitibus approximatis, articulatis, 8–12 cm longis, ca. 1 mm crassis, fuscis, rhachibus minute velutinis setulis castaneis plerisque 0.2 mm longis paucis longioribus; fronde ca. 30 cm longa, 5–8 cm lata, pinnata, rhachi inter pinnas haud alata; pinnis remotis, usque ad 4.5 cm longis, 2 mm latis, plerisque curvis, basi ad rhachin sursum curentibus, coriaceis, superne praecipue ad costas setulis minutis plerisque binatis sparse donatis; soris superficialibus, sporangiis ad latera setulis brevibus atrocastaneis dense armatis.

The most remarkable characteristic of the species is the setulose sporangia, which are as rare in *Ctenopteris* as they are common in New Guinea *Grammitis.* The one-sided dilation of the pinnae is very conspicuous in Brass' specimens.

25. CTENOPTERIS RAWLINSONENSIS Copel.

C. rawlinsonensis COPEL., U. C. Publ. Bot. 18 (1942) 225.

C. rhizomate breve, 3 mm crasso, paleis fuscis linearibus 5 mm longis vestito; stipitibus 10 cm longis 1 mm crassis, fuscis, setis sparsis praeditis mox glabratis, lamina 60 cm longa 6 cm lata, pinnata, rhachi pilis cinnamomeis 1.5 mm longis subsparsis vestita; pinnis erecto-patentibus, remotis, inferioribus sterilibus 4 cm longis 1.5 mm latis, infimis paucis paullo minoribus, medialibus usque ad 4.5 cm longis 3.5 mm latis, longe acuminatis, plerisque falcatis, integris, basi decurrentibus, subcoriaceis, glabris, venis immersis erecto-patentibus, simplicibus; soris supramedialibus superficialibus, receptaculo vix elongato, sporangiis nudis.

NEW GUINEA, Rawlinson Range, alt. 2,000 to 3,600 m. *Mary Strong Clemens 41953.*

Probably near *C. subulatipinna* (v.A.v.R.) Copel., but distinguished from *Brass 11034*, which I regard as that species, by erecto-patent pinnae with strongly decurrent bases not dilated on the upper side, as well as by naked sporangia; near also to *C. pendens* (Ros.) Copel., which likewise has the bases of the pinnae dilated on both sides.

The pinnae of the lower part of the frond are not connected; in the upper part, they are still remote, but connected by a narrow decurrent wing.

26. CTENOPTERIS FUSCA Copel. **Plate 5b.**

C. fusca COPEL., U. C. Publ. Bot. 18 (1942) 225.

Rhizomate valido, brevi-repente, paleis olivaceo-fuscis lanceolatis 5 mm longis ciliatis immerso; stipitibus approximatis, gracilibus, 4–5 cm longis, 0.5–0.8 mm crassis, atrocastaneis, minute pubescentibus, lamina ca. 10 cm longa, deorsum elongato-attenuata, supra basin conspicue arcuatim recurva, pinnata, rhachi castanea, minute sparse pilulosa, pinnis medialibus ca. 7 mm longis, supra basin vix 2 mm latis, apud rhachin paullo contractis, adnatis, paullo deflexis, basi abrupte sursum flexis dorso ad dorsum applicatis, integris vel obscure crenatis, glabris, olivaceo-fuscis, rigide coriaceis, costis venisque immersis occultis; soris superficialibus, orbicularibus, ca. 3-paribus, denique confluentibus, rhachin versus carentibus, sporangiis nudis.

DUTCH NEW GUINEA: 7 km. NE. of Wilhelmina-Top, alt. 3,560 m, *Brass* and *Myer-Drees 9897;* "common tuft epiphyte in moss of subalpine forest; fronds sharply reflexed."

Related to *C. nutans*, but distinct and even unique in appearance. The bending downward of the rachis may bring the

distal part of the frond directly downward, or may even carry it past the stipe, but is still less striking than the uniform upward-bending of the pinnae, bringing their dorsal surfaces flatly into imbricate contact.

27. CTENOPTERIS BLECHNOIDES (Grev.) Wagner and Grether

C. blechnoides (Grev.) WAGNER and GRETHER, U. C. Publ. Bot. 23 (1943) 61.
Grammitis blechnoides GREV., Ann. Mag. Nat. Hist. II 1 (1848) 328. *pl. 12.*

Brass 13444, 13730, 14129, Idenburg River, alt. 75 to 750 m. Already well known in New Guinea.

Tahiti across Malaya.

Mrs. Clemens has sent from Mt. Sarawaket, alt. 11,000 feet, an undescribed plant altogether like *C. blechnoides* in aspect, but with ciliate paleae and superficial sori.

28. POLYPODIUM FLAGELLIFORME Brause

P. flagelliforme BRAUSE, Engl. Jahrb. 56 (1920) 187.

Sepik region, alt. 1,000 m; *Ledermann 10075, 10165a.* Not seen.

29. CTENOPTERIS REPANDULA Kunze *apud* Zoll.

C. repandula KUNZE *apud* ZOLL., Syst. Verz. (1854) 37.

Bele River, alt. 2,200 m, *Brass 11548;* previously reported by Ridley.

CEYLON. This is an improbable range, particularly in this genus.

POLYPODIUM PEDICULATUM Baker

P. pediculatum BAKER, Syn. Fil. (1868) 455.

Brause reports *Ledermann 10028* and *10334* as this species. It was described from Borneo, and, in spite of its illustration, as *P. lobbianum* Hooker, Sp. Fil. IV, Pl. 278 B, I am not sure what it is.

30. CTENOPTERIS CELEBICA (Blume) Copel.

C. celebica (Blume) COPEL., Genera (1947) 219.
Polypodium celebicum BLUME, Enum. (1828) 127; Flora Javae II 179, *pl. 84 B.*

Brass 12128, 12248, 12298, 12663, alt. 1,800 to 2,150 m; reported from the Sepik region, with a variety *aurita,* by Brause.

MALAYA; PHILIPPINES.

Polypodium cryptosorum C. Chr., Index (1906) 520, is reported from New Guinea, but unknown to me there. It is apparently related to *C. celebica* and to *C. geluensis.*

31. CTENOPTERIS STELLATOSETOSA Copel.

C. stellatosetosa COPEL., U. C. Publ. Bot. 18 (1942) 225.

Rhizoma deest. Stipite 4 cm longo, 1.5 mm crasso, terete, setis castaneis patentibus 1.5 mm longis dense vestito; lamina 45 cm longa, utrinque sensim attenuata, subpinnata, rhachi superne dense setulosa, inferne setulis atrocastaneis 0.5–1.0 mm longis conspicue fasciculatis sparsa; pinnis infimis 1.5 mm longis, 7 mm latis, sequentibus semiorbicularibus 4 mm longis, medialibus usque ad 38 mm longis, 4.5 mm latis, recte patentibus, apice rotundatis, basi vix dilatatis contiguis vix confluentibus, integris, coriaceis, minute setuloso-ciliatis, superne glabris, inferne ad et costam secus immersam setulis minutis plerisque binatis ornatis, venis immersis simplicibus; soris supramedialibus, usque ad 17-paribus, receptaculo levissime impresso setulis deciduis circumdatis, sporangiis parvis, nudis.

NEW GUINEA, Morobe, Matap, alt. ca. 1,700 m. *Mary Strong Clemens 40959.*

An immediate relative of *C. celebica* distinguished by the conspicuously fascicled setae; also by broader pinnae and less impressed sori.

32. POLYPODIUM RACHISORUM Christ

P. rachisorum CHRIST, Nova Guinea 8 (1909) 154.

Noord River, *Versteeg 1555*; also, without locality, *Ledermann 7489;* not seen and possibly misplaced here.

33. CTENOPTERIS LEDERMANNI (Brause) Copel., comb. nov.

Davallia Ledermanni BRAUSE, Engler's Jahrb. 56 (1920) 123.
Polypodium subhamato-pilosum v.A.v.R., Bull. Jard. Buit. III No. 5 (1922) 220.

Sepik region, alt. 2,070 m, type; Mt. Tafa, alt. 2,400 m, *Brass 5026*, det. Christensen.

34. CTENOPTERIS BRASSII Copel. **Plate 6a.**

C. Brassii COPEL., U. C. Publ. Bot. 18 (1942) 225.

Rhizomate brevi- repente, paleis pallide olivaceis 7–10 mm longis linearibus ciliatis vestito; stipite 3–12 cm longo, fusco, setis cinnamomeis 1.5–2.0 mm longis vestito; lamina 30 (vel, teste lectore, usque ad 150) cm longa, 3–4 cm lata, utrinque sensim angustata, pinnata, rhachi utraque facie setis atrocastaneis 1.5 mm longis obsita; pinnis ca. 2 cm longis, 5 mm latis, plerisque falcatis, basi basiscopice paullo dilatatis acroscopice subauriculato-adnatis, rigide coriaceis, sparsissime ciliatis, costa venisque immersis inconspicuis; soris marginalibus vel submarginalibus, vallis altis interne et ad ora setosis circumdatis.

DUTCH NEW GUINEA, Lake Habbema, alt. 3,225 m, *Brass 9302*, type "Pendent epiphyte common in forests; fronds to 1.5 m long"; *No. 11000*, alt. 3,000 m, "common low epiphyte in stunted mossy forest," the frond sent for identification 90 cm long, 3 cm wide.

Related to *C. Ledermanni*, but clearly distinguished by the non-confluent pinnae with oblique bases, perhaps also by the rather copious hairs in the craters.

To this species belongs questionably *Brass 9463*, with fronds 30 cm long by 15 mm wide, the nether surface fairly persistently setulose; it may be regarded as distinct, when the range of variation within the species is better understood.

35. CTENOPTERIS VENULOSOIDES Copel. Plate 6b.

C. venulosoides COPEL., U. C. Publ. Bot. 18 (1942) 225.

C. rhizomate 4 mm crasso lignoso, crateris elevatis frondibus abscissis relictis ornato, paleis perpaucis 1.5 mm longis atrofuscis integris sparso; stipitibus 15 cm longis, fuscis, fere glabratis, lamina 45 cm longa, 4–5 cm lata, pinnata, rhachi nigra setis brevibus nigris praecipue inferne dense obsita, pinnis recte patentibus, 1.5 mm latis, linearibus, subacutis, basibus modo dilatatis fere contiguis, rigide papyraceis, sparsissime ciliatis aliter glabris, venis facie superiore conspicuis simplicibus, angulo acuto distantibus; soris impressis, e facie superiore laminae more C. contiguae, conspicuis, receptaculo elliptico, costae fere parallelo, leviter circumvallato, haud ciliato.

NEW GUINEA, Morobe, Rawlinson Range, alt. 2,000 to 3,600 m. *Mary Strong Clemens 41394*.

Distinguished from *C. venulosa* Kunze by long stipe, denser, shorter and darker hairs on the rachis, position of sori, and absence of hairs on or within the rim of the soral depression. *Polypodium flagelliforme* Brause is known to me by description only; it is described as with short stipe, densely hairy with "pilis porphyreis," and round, subimmersed sori.

I have three fragments of the rhizome of *C. venulosoides*, bearing very few and old paleae. In the absence of the tip of the rhizome, the paleae are only doubtfully known.

36. CTENOPTERIS OBLIQUATA (Blume) Copel., comb. nov.

Polypodium obliquatum BLUME, Enum. (1828) 128; Flora Javae 181, *pl. 85 B.*

C. rufescens KUNZE, Bot. Zeit. 4 (1846) 425.

Two varieties have been decribed from New Guinea: var. *novoguineensis* ROS., Fedde's Repert. 5 (1908) 374.

Gelu, alt. 1,000 m; *Wagner 45a,* isotype in Herb. Univ. Calif. This is a large form, reasonably treated as a variety by those who use the term.

Var. *multijuga* Ros., Fedde's Repert. 12 (1913) 178, from Mt. Bolan, alt. 2,400 to 3,000 m, *Keysser B 45,* isotype in Herb. Univ. Calif. This is really not very near to *C. obliquata,* but may not be distinct from *C. venulosa.*

37. CTENOPTERIS SHAWII Copel., comb. nov. **Plate 7.**

Polypodium Shawii COPEL., Philip. Jour. Sci. § C 9 (1914) 6.

Papua: Taupota, *King 424.* Known by the one collection.

38. CTENOPTERIS MULTICAUDATA Copel., comb. nov.

Polypodium multicaudatum COPEL., Philip. Jour. Sci. 1 Suppl. (1906) 160, *pl. 19.*

Brass 13653, Idenburg River, alt. 700 m, occasional epiphyte in rain forest. The pinnae are less attenuate than on the type, but it is within the range of variation in Mindanao. It is a much coarser plant than *C. obliquata* v. *novoguineensis,* the pinnae more remote and rather irregularly placed, as is true of all Mindanao specimens.

39. CTENOPTERIS CIRCUMVALLATA (Ros.) Copel., comb. nov.

Polypodium circumvallatum Ros., Fedde's Repert 5 (1908) 374.

Bolan, alt. 3,400 to 3,800 m; *Keysser II 39;* isotype in Herb. Univ. Calif.

The preceding five species are a group intimately related to *Prosaptia,* some have been included in that genus, and all might be; but it is impracticable to draw a line between them and the many species preceding them.

40. CTENOPTERIS CONGREGATIFOLIA (v.A.v.R.) Copel., comb. nov.

Polypodium congregatifolium v.A.v.R., Nova Guinea 14 (1924) 47.

Doorman-Top, alt. 1,420 m, *Lam 1544,* isotype in Herb. Univ. Calif; Bele River, alt. 2,200 m, *Brass 11271.*

41. CTENOPTERIS ALLOCOTA (v.A.v.R.) Copel., comb. nov.

Polypodium allocotum v.A.v.R., Nova Guinea 14 (1924) 47.

Doorman-Top, alt. 3,200 m, *Lam 1800;* Lake Habbema, alt. 3,225 m, *Brass 9466.*

42. CTENOPTERIS EXIMIA Copel.

Polypodium eximium BRAUSE, Engl. Jahrb. 56 (1920) 186, *non* Kunze.

Sepik region, alt. ca. 1,500 m, *Ledermann 12666a,* type, not seen; Idenburg River, alt. 1,200 to 1,800 m, *Brass 12818, 12373.*

This species is without a name valid for transfer from *Polypodium*, and I give it, without transfer, the name *eximia*, valid in *Ctenopteris*.

43. CTENOPTERIS TENUISECTA (Blume) J. Smith

C. tenuisecta (Blume) J. SMITH, Hist. Fil. (1875) 185.
Polypodium tenuisectum BLUME, Enum. (1828) 134.

Several collections in German New Guinea; Doorman-Top, alt. 2,460 m, *Lam 1938*. The variety *paucisetosa* Ros., Fedde's Repert. 5 (1908) 42, from Gelu, *Werner 29*, is the form common in the Philippines, not really distinguishable.

The type was from Java.

44. CTENOPTERIS TAXODIOIDES (Baker) Copel., comb. nov.

Polypodium taxodioides BAKER, Jour. Bot. II 8 (1879) 42.

Brass 11597, 10276, Lake Habbema region, alt. 2,200 to 2,800 m.

Rosenstock's variety *ericoides*, from Bolan, alt. 2,400 to 3,000 m, *Keysser II 77*, is indistinguishable.

45. CTENOPTERIS YODERI Copel.

C. Yoderi COPEL., Genera (1947) 219.
Polypodium Yoderi COPEL., Philip. Jour. Sci. 1 Suppl. (1906) 161.
P. tamiense BRAUSE, Engl. Jahrb. 49 (1912) 43, *teste* Brause.

Rosenstock's variety *setulosa*, Fedde's Repert. 12 (1913) 179, from Bolan, alt. 2,400 to 3,000 m, *Keysser II 77a*, is not distinguishable. The collection of mixtures in this group is worthy of attention.

46. CTENOPTERIS MILLEFOLIA (Blume) Copel.

C. millefolia (Blume) COPEL., Genera (1947) 219.
Polypodium millefolium BLUME, Enum. (1828) 134; Flora Javae II 190, *pl. 88 A*.

Brass 10277, 12349, 13205, alt. 850 to 2,800 m; Sattelberg, *Keysser 244*. As I construe it, this species is variable in several respects, and I am unable to distinguished:

Polypodium Alderwereltii Ros., C. Chr. Index Suppl. I (1931) 58.
P. Koningsbergeri Ros., Nova Guinea 8 (1912) 726, non *v.A.v.R.*
P. rigidifrons v.A.v.R., Bull. Jard. Buit. II No. 20 (1915) 23.
P. Wollastonii RIDLEY, Trans. Linn. Soc. Bot. II 9 (1916) 262, which appears to differ only in having an elongate rhizome, being in that respect like *C. taxodioides* and *C. Yoderi*.

The preceding five species probably constitute Moore's Section *Thymelium* of *Polypodium*, typified by *P. tenuisectum* Blume. They are a natural group, but not very nearly related to the following species with equally dissected fronds.

47. CTENOPTERIS SUBSECUNDODISSECTA (Zoll.) Copel., comb. nov.

Polypodium subsecundodissectum ZOLL., Syst. Verz. (1854) 38, 48.

Brass 11338, Bele River, alt. 2,200 m; pinnae strongly recurved. I suppose that this is *Polypodium secundum* Ridley, Trans. Linn. Soc. Bot. II 9 (1916) 262, from the same region.

48. CTENOPTERIS SESQUIPINNATA Copel.

C. sesquipinnata COPEL., U. C. Publ. Bot. 18 (1942) 225.

C. rhizomate breve, erecto, radicibus stipitibusque obsesso, paleis ut videtur carentibus; stipitibus fasciculatis, ca. 3 cm longis, gracilibus, pilis paucis pallidis fragilibus 1 mm longis vestitis; lamina 35 cm longa, 2 cm lata, debiliter pendente, pinnata, rhachi sparsissime decidue hirta, sursum anguste alata; pinnis erecto-patentibus, 12 mm longis, 2.5 mm latis, subacutis, oblique adnatis, inconspicue decurrentibus, firme herbaceis, pinnatifido-serratis, pilis paucis parvis deciduis sparsis; venis brevibus, vix in dentes entrantibus; soris superficialibus, orbicularibus, costalibus, dentes non complentibus, sporangiis nudis.

DUTCH NEW GUINEA, Lake Habbema, alt. 3,225 m, *Brass 9510,* common epiphyte in closed mossy forest.

Related to *C. bipinnatifida,* but slender, symmetrical, and much less hairy.

49. CTENOPTERIS BIPINNATIFIDA (Baker) Copel., comb. nov.

Polypodium bipinnatifidum BAKER, JOURN. Bot. 28 (1890) 109.

Brass and *Myer–Drees 9903,* Wilhelmina-Top, alt. 3,560 m; *Mrs. Clemens,* Mt. Sarawaket, alt. 9,000 to 11,000 feet. The type was collected by MacGregor on the Owen Stanley Range. A peculiar species, quite indefinite in size, forming pendent tufts, the fertile and sterile parts of the same frond sometimes very unlike. The variety *Forsteri* Ros., Fedde's Repert. 12 (1913) 179, is a hairy form, perhaps exceptionally so.

50. CTENOPTERIS POLYTRICHA Copel. **Plate 9.**

C. polytricha COPEL., U. C. Publ. Bot. 18 (1942) 225.

C. rhizomate erecto, breve, radicibus et stipitibus occulto, paleis vestigialibus; stipitibus ca. 5 cm longis, gracilibus, frondibusque ubique pinis albidis ferruginescentibus 2–4 mm longis densissime obsitis; fronde 40 cm longa vel longiore, 2 cm lata, pinnata, basin versus longe attenuata, rhachi sursum angustissime alata; pinnis 5–10 mm longis, 3–4 mm latis, obtusis, adnatis et inconspicue decurrentibus, pinnatifide-lobatis, membranaceo-herbaceis; lobis, resp. dentibus, ca. 1 mm longis latisque, rotundatis, momophlebiis et monosoris; soro superficiale, orbiculare, lobum complente, sporangiis nudis.

DUTCH NEW GUINEA: 9 km NE. of Lake Habbema, alt. 2,860 m, *Brass 10518*, rare tuft epiphyte in mossy forest.

Related to *C. bipinnatifida* and C. *beleensis*.

51. CTENOPTERIS BIPINNATA Copel. **Plate 10.**

C. bipinnata COPEL., U. C. Publ. Bot. 48 (1942) 225.

C. rhizomate breve, paleis paucis fuscis vix 1 mm longis basibus pilosis stipitum occultis vestito; stipite breve rhachique flexuosa gracillimis, 0.3–0.4 mm crassis, pilis pallide fulvis 1.5–2.0 mm longis debilibus sursum decrescentibus et caducis vestitis; lamina 30–60 cm longa, lineare, bipinnata; pinnis 2–3 cm longis, angulo acuto pendentibus, rhachibus filiformibus vix alatis; pinnulis remotis, adnatis, plerisque obovatis, ca. 1 mm longis, glabris, venula simplice, soro parvo inframediale.

DUTCH NEW GUINEA, Lake Habbema, alt. 3,225 m, *Brass 9433*, pendent under leaning trees in mossy forest.

An immediate relative of *C. bipinnatifida*, but much more finely divided.

7. PROSAPTIA Presl

The recognition of *Prosaptia* as a genus distinct from *Ctenopteris* is purely a matter of convenience. Its affinity to *Ctenopteris* is evident and intimate. With a different idea of convenience, or with more compelling respect for affinity, one may reasonably combine the two genera. More than elsewhere, the distinction is difficult in New Guinea, which may well be the land where *Prosaptia* became differentiated.

Key to the species

Sori marginal, approximately in the laminar plane.
  Sori plural, or terminal on segments.
    Sori occupying lobes or teeth.
      Hairs on stipe under 0.5 mm long ..... 1. *P. contigua*
      Hairs on stipe and rachis 1–2 mm long ..... 2. *P. Archboldii*
    Margin entire or crenate.
      Pinnatifid within 1 mm of costa ..... 4. *P. Rosenstockii*
      Less deeply pinnatifid ..... 4. *P. alata*
  Sorus single on acroscopic margin ..... 7. *P. davalliacea*
Sori almost marginal in oblique pits.
  Frond 5–8 mm broad ..... 8. *P. capillipes*
  Frond much wider.
    Segments up to 2.5 mm broad ..... 6. *P. Leysii*
    Segments over 3 mm broad ..... 5. *P. engleriana*

1. PROSAPTIA CONTIGUA (Forster) Presl

P. contigua (Forster) PRESL, Tent. (1836) 166.
Trichomanes contiguum FORSTER, Prod. (1786) 84.

Sattelberg, alt. 900 m, *Bamler 90;* Ins. Rook, *Bamler R 24.*

Typical *C. contigua* is pinnate to the rhachis but the pinnae are contiguous. The hairs on the stipe are very short, dense but not always persistent, almost wholly solitary, and the pinnae and their segments are conspicuously narrow.

POLYNESIA.

2. PROSAPTIA ARCHBOLDII Copel.

P. Archboldii COPEL., U. C. Publ. Bot. 18 (1942) 226.

P. contiguae affinis et similis, soris etiam dentes pinnarum complentibus, differt; fronde usque ad rhachin pinnata pinnis medio longitudine frondis non contiguis, setis stipitis 1–2 mm longis rhacheosque inferne saepe binatis vel ternatis.

DUTCH NEW GUINEA: 15 km SW. of Bernhard Camp, Idenburg River, alt. 1,200 m, *Brass 12020,* type, low tufted epiphyte in mossy forest; also *Brass 10631, 10700, 11032, 11594, 12794,* altitudes 1,200 to 2,000 m.

3. PROSAPTIA ALATA (Blume) Christ

P. alata (Blume) CHRIST, Ann. Jard. Buit. II 5 (1905) 127.
Davallia alata BLUME, Enum. (1828) 230.

GERMAN NEW GUINEA, *Bamler; Ros., Fil. Novog. Excicc. 213;* Reported as collected by Werner also.

JAVA; SUMATRA.

Frond decurrent almost to rhizome, pinnatifid to a very broad wing, with acute sinuses.

4. PROSAPTIA ROSENSTOCKII Copel.

P. Rosenstockii COPEL., U. C. Publ. Bot. 12 (1931) 404.

Ins. Rook, alt. 240 m, *Bamler 23 R.*

5. PROSAPTIA ENGLERIANA (Brause) Copel.

P. engleriana (Brause) COPEL., U. C. Publ. Bot. 12 (1931) 404.
Davallia engleriana BRAUSE, Engl. Jahrb. 49 (1912) 37, *f. 1 H.*

GERMAN NEW GUINEA, Kelel, alt. 600 m; two isotype sheets in Herb. Univ. Calif.

Fronds 30 to 85 cm long, pinnae narrowly confluent.

6. PROSAPTIA LEYSII (Baker) Copel., comb. nov.

Polypodium Leysii BAKER, Jour. Bot. II 8 (1879) 66.
Prosaptia semicrypta COPEL., Philip. Jour. Sci. § C 9 (1914) 231.

Brass 4610, Central Division, Murray Pass, alt. 2,840 m, det. Christensen, Brittonia 2 (1937) 310.

Distinctly more coriaceous than the typical plants of Sulu, Malacca and Sumatra.

7. PROSAPTIA DAVALLIACEA (Mueller and Baker) Copel.

P. davalliacea (Mueller and Baker) COPEL., U. C. Publ. Bot. 12 (1931) 404.
P. davalliaceum MUELLER and BAKER, Jour. Bot. 28 (1890) 108.
P. monocarpum ROS., Fedde's Repert. 12 (1913) 178.

Wilhelmina-Top, alt. 3,400 m, *Brass* and *Myer-Drees 9650*; Mt. Sarawaket, alt. 8,000 to 11,000 feet, *Mrs. Clemens*. The type is an older New Guinea collection.

BORNEO, Mt. Kinabalu, *teste* Christensen, Gardens' Bull. 7 (1934) 303.

P. linearis, of Luzon, is similar rather than identical.

8. PROSAPTIA CAPILLIPES (C. Chr.) Copel., comb. nov.

Polypodium capillipes C. CHR. Brittonia 2 (1937) 310.

Central Division, Murray Pass, alt. 2,840 m, *Brass 4731;* Mt. Albert Edward, alt. 3,680 m, *Brass 4413*.

The smallest plant of its genus; nearest, but not very nearly, related to *P. davalliacea*. The soral pits are oblique, rather than perpendicular, to the plane of the lamina.

8. LOXOGRAMME (Blume) Presl

Botanists are not in agreement as to the proper place of this genus, Ching going so far as to make it a distinct family. All New Guinea specimens seem properly to belong in Grammitidaceae.

Key to the species

Fronds about 5 cm wide, oblanceolate ..... 1. *L. scolopendrina*
Fronds much narrower.
  Fructification interrupted ..... 2. *L. subselliguea*
  Coenosorous continuous ..... 3. *L. paltonioides*

1. LOXOGRAMME SCOLOPENDRINA (Bory) Presl

L. scolopendrina (Bory) PRESL, Tent. (1836) 215.
Grammitis scolopendrina BORY, Voy. Dup. Bot. 1 (1828) 257.

GERMAN NEW GUINEA, Finisterre Mts., *Werner 10; Bamler 40a;* Papua, *King 297*.

To Guadalcanal and Malacca; the type ascribed in error to New Zealand.

2. LOXOGRAMME SUBSELLIGUEA (Baker) Alston

L. subselliguea (Baker) ALSTON, Jour. Bot. 77 (1939) 289.
Polypodium subselligueum BAKER, Jour. Bot. 28 (1890) 107.
L. parallela ROS., in herb.; ALSTON, *l.c.*, *non* Copel.
L. major COPEL., Philip. Jour. Sci. 56 (1935) 106.

The type, a fragment from Mt. Knutsford, not seen; Mt. Sarawaket, *Clemens s. n.;* Bolan, alt. 2,400 to 2,800 m. *Keysser*

II 40, II 81; Lake Habbema region, *Brass 9221, 10254, 11240;* Idenburg River region, alt. 850 m, *Brass 13374.* More than one species may be confused here.

MINDANAO; BORNEO.

3. LOXOGRAMME PALTONIOIDES Copel.

L. paltonioides COPEL., Philip. Jour. Sci. § C 6 (1911) 87; 11 (1916) *pl. 4, fig. 15.*

Paltonium vittariiforme ROS., Fedde's Repert. 10 (1912) 341; C. CHR. Dansk bot. Arkiv 6 No. 3: 52, *pl. 7, fig. 1, 2.*

L. vittariiformis C. CHR., Brittonia 2 (1937) 315.

Papua, *King 253,* type of *L. paltonioides;* Cromwell Mts. *Bamler s. n.,* type of *Palt. vittariiforme;* Mt. Tafa, alt. 2,400 m, *Brass 5090, teste* C. Chr.; Bernhard Camp. Idenburg River, *Brass 12377, 12378, 12383.*

Endemic.

The type of *P. vittariiforme* is a single frond, and I find nothing in its description to distinguish it from *L. paltonioides.* Christensen saw it, and I follow him in the identification of all Brass collections; these are stouter, far larger and narrower, and do not look like the same species.

ILLUSTRATIONS

[All plates are from photographs, by V. Duran, of types in the herbarium of the author.]

PLATE 1a. Xiphopteris antipodalis
b. Calymmodon grammitidiphyllus
2. Calymmodon ramifer
3. Calymmodon fragilis
4a. Ctenopteris integripaleata
b. Ctenopteris Clemensiae
5a. Ctenopteris pubipes
b. Ctenopteris fusca
6a. Ctenopteris Brassii
b. Ctenopteris venulosoides
7. Ctenopteris Shawii
8. Ctenopteris sesquipinnata
9. Ctenopteris polytricha
10. Ctenopteris bipinnata